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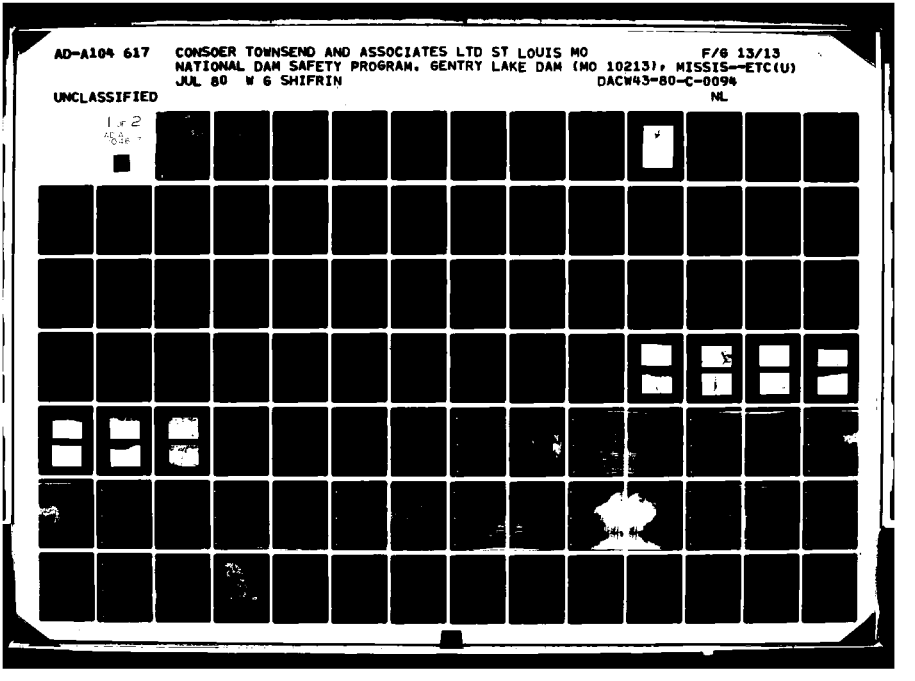

MISSISSIPPI · SALT · QUINCY RIVER BASIN

GENTRY LAKE DAM
LINCOLN COUNTY, MISSOURI
MO. 10213

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
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St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JULY 1980

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Gentry Lake Dam (Mo. 10213) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Gentry Lake Dam (Mo. 10213).

It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division

28 AUG 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

29 AUG 1980
Date

GENTRY LAKE DAM
LINCOLN COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10213

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
CONSOER, TOWNSEND AND ASSOCIATES, LTD.
ST. LOUIS, MISSOURI
AND
PRC ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO
A JOINT VENTURE

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

JULY 1980

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Gentry Lake Dam, Missouri Inv. No. 10213
State Located: Missouri
County Located: Lincoln
Stream: An unnamed tributary of the Lost Creek
Date of Inspection: April 22, 1980

Assessment of General Condition

Gentry Lake Dam was inspected by the engineering firms of Consoer, Townsend and Associates, Ltd. and PRC Engineering Consultants, Inc. (A Joint Venture) of St. Louis, Missouri according to the U. S. Army Corps of Engineers "Engineer Regulation No. 1110-2-106" and additional guidelines furnished by the St. Louis District of the Corps of Engineers. Based upon the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. Within the estimated damage zone of four miles downstream of the dam are four dwellings, five buildings, three barns, one quarry scale house, and a dam which may be subjected to flooding, with possible damage and/or destruction, and possible loss of life. Gentry Lake Dam is in the small size classification since it is less than 40 feet and more than 25 feet high, and impounds more than 50 acre-feet but less than 1,000 acre-feet of water.

Our inspection and evaluation indicates that the spillway of Gentry Lake Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Gentry Lake Dam being a small size dam with a high hazard potential is required by the guidelines to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping. Considering the number of inhabited dwellings located downstream of the dam and another dam being located on the same stream approximately 1 mile downstream of the dam, the PMF is considered the appropriate spillway design flood for Gentry Lake Dam. It was determined that the reservoir/spillway system can accommodate approximately 80 percent of the Probable Maximum Flood without overtopping the dam. Our evaluation also indicates that the reservoir/spillway system can accommodate the one-percent chance flood without overtopping.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region.

Other deficiencies noted by the inspection team were the two larger sized bush plants on the downstream slope, old brush and logs in and around the principal spillway outlet, brush and trash on the downstream half of the emergency spillway channel, eroded areas in the vicinity of the emergency spillway discharge channel, livestock activities on the dam embankment, a need for periodic inspection by a qualified engineer and a lack of maintenance schedule. The lack of seepage and stability analyses on record is also a deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described above.

Walter G. Shifrin, P.E.

Overview of Gentry Lake Dam

NATIONAL DAM SAFETY PROGRAM

GENTRY LAKE DAM, I.D. No. 10213

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NATIONAL DAM SAFETY PROGRAM

GENTRY LAKE DAM, Missouri Inv. No. 10213

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for Gentry Lake Dam was carried out under Contract DACW 43-80-C-0094 between the Department of the Army, St. Louis District, Corps of Engineers, and the engineering firms of Consoer, Townsend & Associates, Ltd., and PRC Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of Gentry Lake Dam was made on April 22, 1980. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project, presents a summary of visual observations made during the field inspection, presents an assessment of hydrologic and hydraulic conditions at the site, presents an assessment of the structural adequacy of the various project features and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing and detailed analyses were not within the scope of this study. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that in this report reference to left or right abutments is viewed as looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to the west abutment or side, and right to the east abutment or side.

d. Evaluation Criteria

The inspection and evaluation of the dam is performed in accordance with the U.S. Army Corps of Engineers "Engineer Regulation No. 1110-2-106" and additional guidelines furnished by the St. Louis District office of the Corps of Engineers for Phase 1 Dam Inspection.

1.2 Description of the Project

a. Description of Dam and Appurtenances

The following description is based upon observations and measurements made during the visual inspection and from conversations with Mr. M. Gentry, the owner. "As-Built" drawings are included as part of this report. There were no major discrepancies between our field notes and the "As-Built" plans.

The dam consists of a zoned, rolled, earthfill embankment with a straight alignment between earthen abutments. Material was removed from the reservoir and local area for construction of the embankment, which, according to Mr. Gentry, includes an impervious clay core wall founded on bedrock. The shape of the dam's maximum cross-section is generally trapezoidal with a 14 foot top thickness and a structural height of 31 feet. The total horizontal distance along the axis at the top of dam was measured as 473 feet; the elevation at the top of dam is 724.5 feet above mean sea level (M.S.L.)

The upstream slope was measured as 1.0 V to 2.8 H to the berm and the downstream slope as 1.0 V to 2.1 H. A 10-foot wide berm was constructed on the upstream slope approximately 13 feet below the top of dam.

Included in the length measurement along the axis is an emergency spillway, trapezoidal in shape, cut into the dam at the right abutment. This spillway is a grass-lined open channel with a measured 79-foot top width and 33 foot spillway crest width, which is approximately 5.5 feet below the top of dam. The left and the right side slopes of the channel is 1.0 V to 3.5 H and 1.0 V to 4.9 H respectively.

The principal spillway for Gentry Lake Dam is an 18 inch concrete conduit laid through the embankment with seepage collars placed on bedrock. The spillway intake is about 294 feet right of the left abutment and consists of a drop inlet concrete standpipe with a 12 foot drop (Photo 6). The concrete standpipe, also founded on bedrock (see Plate 9), has a 36-inch inside diameter and joins to the 18-inch diameter concrete conduit, which then outlets into a 4 foot deep, 25 foot diameter pool near the toe of the embankment (Photo 7). Using field measurements, the length of the 18 inch conduit was calculated as 122 feet. Affixed to the top of the standpipe is a metal trashrack and concrete anti-vortex wall combination. The wall is 4 inches thick, 2 feet high and about 12 feet in length, and is oriented in the direction of the 18 inch pipe. The trashrack, bolted to the anti-vortex wall, consists of welded steel channels (Photo 6).

There are no low level outlets, gates, or other appurtenant structures associated with this dam.

b. Location

Gentry Lake Dam is located in Lincoln County in the State of Missouri, and crosses an unnamed tributary of Lost Creek. The small community of Elsberry is about seven miles to the east. The Gentry Lake Dam location on the 7.5 minute series of the U.S. Geological Survey maps is found in Section 7 of Township 50 North, Range 2 East, of the Luckett Ridge, Missouri Quadrangle Sheet.

c. Size Classification

The impoundment of Gentry Lake Dam is less than 1,000 acre-feet but more than 50-acre feet, and the height is within the 25 to 40 foot range. Therefore the size is determined to fall in the "small" category, according to the "Engineer Regulation No. 1110-2-106, Appendix D" by the U.S. Department of the Army, Office of the Chief Engineer.

d. Hazard Classification

The dam has been classified as having a "high" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur with this classification. Within the estimated damage zone, extending four miles downstream of the dam, are four dwellings, five buildings, three barns plus another dam and a quarry scale house.

e. Ownership

Gentry Lake Dam and Reservoir is privately owned. The owner's name is Moebius Gentry; his address is as follows: R.F.D. 1, Elsberry, Missouri, 63343.

f. Purpose of Dam

The dam was constructed as a flood control structure, however, the reservoir is also used for a livestock drinking water supply.

g. Design and Construction History

Gentry Lake Dam was designed by the Department of Agriculture, Soil Conservation Service as part of the Lost Creek Watershed Protection Project. Mr. Bernard Browning was the Soil Conservation Service engineer for the project. According to the owner, Mr. Moebius Gentry, the dam was constructed between July, 1959 and September, 1959 by Gamett & Wilson Construction Company, of Clark County, Missouri.

h. Normal Operational Procedures

Normal procedure is to allow the reservoir to remain as full as possible with the water level being controlled by rainfall, runoff, evaporation and the elevation of the principal spillway crest.

1.3 Pertinent Data

a. Drainage Area (square miles):. 0.29

b. Discharge at Damsite

Estimated experienced maximum flood (cfs): 30

Estimated ungated spillway capacity with reservoir at top of dam elevation (cfs): 1985

c. Elevation (Feet above MSL)

Top of dam (minimum):. 724.5

Spillway crest:

Principal Spillway 709.5

Emergency Spillway 719.0

Normal Pool: 709.5

Maximum Experienced Pool:. 716.0

Observed Pool 709.5

d. Reservoir

Length of pool with water surface at top of dam elevation (feet):. 1100

e. Storage (Acre-Feet)

Top of dam (minimum):. 123

Spillway crest:

Principal Spillway 17

Emergency Spillway 70

Normal Pool: 17

Maximum Experienced Pool 48.5

Observed Pool. 17

f. Reservoir Surfaces (Acres)

Top of dam (minimum):. 11.7

Spillway crest:

Principal Spillway	3.5
Emergency Spillway	7.9
Normal Pool:	3.5
Maximum Experienced Pool:	6.4
Observed Pool:	3.5

g. Dam

Type:	Rolled, Earthfill
Length:	473 feet
Structural Height:	31 feet
Hydraulic Height:	31 feet*
Top width:	14 feet
Side slopes:	
Downstream	1V to 2.1H (measured to berm)
Upstream	1V to 2.8H (measured to berm)
Zoning:	a. Impervious clay core (according to Mr. Gentry) b. Upstream and downstream clay and chert shells
Impervious core:	yes
Cutoff:	A core trench 4-foot deep with 10-foot bottom width and side slopes of 1H to 1V.
Grout curtain:	no
Freeboard above normal reservoir level:	15 feet
Volume:	24,259 cu.yds. (according to as-built plans)

h. Diversion and Regulating Tunnel — None

i. Spillway

Type:

Principal Spillway	Drop inlet, uncontrolled
Emergency Spillway	Earthcut channel, uncontrolled
Length of crest:	
Principal Spillway	3-foot diameter standpipe with an 18-inch diameter connecting pipe
Emergency Spillway	33 feet
Crest Elevation (feet above MSL):	
Principal Spillway	709.5
Emergency Spillway	719.0

j. Regulating Outlets . . . None

* The hydraulic height of the dam is the vertical distance from the lowest point on the downstream toe to the top of the dam or the maximum water surface, if below the top of the dam.

SECTION 2: ENGINEERING DATA

2.1 Design

"As-built" drawings are available from the Department of Agriculture, Soil Conservation Service, and are included as part of this report. The drawings were prepared in April, 1958 by the Department of Agriculture, Soil Conservation Service. Geologic and soil mechanics reports were prepared for this dam by the Department of Agriculture, Soil Conservation Service, however, they were not available during the preparation of this report.

2.2 Construction

No data is available concerning the construction of the dam and appurtenant structures, other than the "As-built" drawings, and the information obtained from Mr. Gentry.

According to Mr. Gentry, the embankment consists of three zones as follows: an impervious core, and an upstream and a downstream shell. The core was constructed of a clay material removed from the right abutment area and the two shells were constructed of a clay and chert material removed from the reservoir. The embankment was compacted by a sheepfoot roller and density tests were taken at an interval of at least one per day. A 4-foot deep core trench was excavated to bedrock (shale) and parallel to the dam axis. This corresponds to what is shown on the "As-built" drawings. The trench has a bottom width of 10 feet and side slopes of 1V to 1H.

2.3 Operation

No operation records are available for Gentry Lake Dam.

2.4 Evaluation

a. Availability

The availability of engineering data is fair and consists of the "As-built" drawings mentioned in Section 2.1, State Geological Maps and U.S.G.S. Quadrangle Sheets. Geologic and soil mechanics reports for this dam were prepared by the Department of Agriculture, Soil Conservation Service, however, they were not available during the preparation of this report. Information on design hydrology and hydraulic design is available and is included in this report (Plate 13 and 14). Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams", were not available which is considered a deficiency.

b. Adequacy

The conclusions presented in this report are based on field measurements, the available engineering data, past performance and present condition of the dam. The available data including the field measurements taken by the field inspection team are considered adequate to evaluate the hydraulic and hydrologic capabilities of the dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Validity

A set of "As-built" drawings and information on design hydrology and hydraulic design were available for review. From field measurements and conversations with the owner, the dam appears to have been constructed according to the available drawings, except for the discrepancies described in Section 6.1b. Gentry Lake Dam was originally Structure E-1 according to the "As-built" drawings provided by the Soil Conservation Service.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Gentry Lake Dam was made on April 22, 1980. The following persons were present during the inspection:

Name	Affiliation	Disciplines
Dr. M.A. Samad	PRC Engineering Consultants, Inc.	Project Engineer, Hydraulics and Hydrology
Mark R. Haynes	PRC Engineering Consultants, Inc.	Soils and Mechanical
Robert McLaughlin	PRC Engineering Consultants, Inc.	Civil
Razi Quraishi	PRC Engineering Consultants, Inc.	Geology
John Lauth	Consoer, Townsend & Assoc., Ltd.	Civil and Structural
Moebius Gentry	Owner	

Specific observations are discussed below.

b. Dam

The dam is well maintained and is generally in good condition. The top of dam area shows no vehicular wear in the grass cover protection which seems to be adequate (Photo 1). No cracking or misalignments in either the vertical or horizontal directions were apparent during the visual inspection; also there were no localized settlements or bulges observed. According to Mr. Gentry, not only has there never been an occurrence of overtopping, but the emergency spillway has never been used. There was no evident animal burrowing activity.

The upstream slope has adequate grass cover; however, there are livestock trails in the vicinity of the berm near the water's edge (Photo 2). Although this presents no hazards, it is mentioned because some portions of the berm seemingly have been cut back, as much as six to ten feet, by the cutting effect of the hooves of cattle. This condition has allowed a small amount of erosion to occur due to wave action. Also, there is a pile of old logs and rubbish stored behind the trashrack; this poses a slight potential problem as there is no trashrack cross-bar to block entry into the drop inlet from the rear. No bulges, depressions or other irregularities were observed.

The downstream slope also has adequate grass cover. Although no seepage was encountered either on the slope or downstream of the toe, there are two fairly good sized shrubs growing on the slope (Photo 5). No bulges, depressions, or other signs of instability were apparent. Some livestock paths were worn into the slope itself and along the line of intersection of the dam and emergency spillway fill (Photo 10). No animal burrows were observed.

Both abutments slope gently upward from the crest of the dam. No instabilities or seepage were observed on either abutment. One erosion gully was observed on the right abutment several feet to the right of the emergency spillway. The erosion did not appear to affect the safety of the emergency spillway, dam, or abutment.

No rodent activity was apparent on the abutments. According to Mr. Gentry, there has been some muskrat activity in the reservoir in the past. The muskrats are trapped during the winter when present.

c. Project Geology and Soils

(1) Project Geology

The damsite is located on an unnamed tributary of Lost Creek in the Dissected Till Plains Section of the central Lowland Physiographic Province. Loess-mantled Kansas drift covers the surface of most of the Dissected Till Plains Section. This section is distinguished from the Young Drift Section to the north and from the Till Plains on the east by the stage it has reached in the post-glacial erosion cycle. Broadly generalized, this section is a nearly flat till plain submature to mature in its erosion cycle.

The regional bedrock geology beneath the glacial outwash deposit in the damsite area as shown on the Geologic Map of Missouri (1979) (Plate 16) consists of Mississippian Burlington limestone, Fern Glen Formation, and Ordovician rocks consisting of interbedded limestone, sandstone, and shale.

The topography at the damsite is rolling with V- to U-shaped valleys. Elevation ranges from 930 feet above M.S.L. (2 miles northeast of the site) to about 720 feet above M.S.L. at Gentry Lake. The reservoir slopes are generally 10^{o} to 15^{o} from horizontal. The area near the damsite is covered with slope wash deposits of glacial-fluvial and loess origin, consisting of brown, silty, fine sand with brown sandstone fragments. Inlet and outlet areas of the unnamed tributary of Lost Creek exhibits Quaternary Alluvium. Outcrops of Ordovician Maquoketa Shale are exhibited at the downstream channel of the spillway and at the inlet areas of a southeasterly creek. Maquoketa Shale exhibited at the site consists of yellowish gray, moderately hard, thinly laminated, horizontally bedded Calcareous to Dolomitic shale with local lenses of limestone (Photos 13 and 14).

No faults have been identified in the vicinity of the damsite. The closest trace of a fault to the damsite is the Cap Au Gres faulted flexture nearly 5 miles southwest of the site. The Cap Au Gres faulted flexture had its last movement in post-Pennsylvanian, pre-Pleistocene time. Thus, the fault appears to have no effect on the dam.

Gentry Lake Dam consists of a zoned earthfill embankment and a grass lined spillway which is located at the right end of the embankment.

Based on the visual inspection, construction drawings and from the personal communication with the owner, Mr. Gentry, the embankment probably rests on gray, hard Maquoketa Shale. The foundation materials underneath the spillway area is compacted embankment fill (brown clayey silt, some fine sand).

(2) Project Soils

According to the "Missouri General Soil Map and Soil Association Descriptions" published by the Soil Conservation Service, the materials in the general area of the dam belong to the soil series of Menfro-Winfield-Lindley in the central Mississippi Valley wooded slopes family. The soils were basically formed from loess and glacial till. The permeability of these soils range from moderate to moderately slow. The Lindley soil is generally quite susceptible to erosion. If the Lindley soil type was used in the embankment, the potential of failure of the embankment would be increased due to erosion during overtopping.

Materials removed from the embankment on the upstream and downstream slopes approximately 1 foot below the vegetative cover appeared to be a brownish clayey silt with some fine sand. Based upon the Unified Soil Classification System, the soil would probably be classified as an ML-CL. This soil type generally has the following characteristics: impervious with a coefficient of permeability less than 1.0 foot per year; medium to low shear strength; and an intermediate resistance to piping.

d. Appurtenant Structures

(1) Principal Spillway

The principal spillway seemed to be in generally good shape. No major cracks were seen in the concrete in either the standpipe overflow rim or the anti-vortex wall, although some minor pitting was observed in the wall. Also, the metal trashrack, bolted to the wall, had no protective coating and a moderate amount of rust was present along with

possible corrosion at the water line (Photo 6). According to the "As-built" plans, paragraph 2.1, the spillway conduit was tongue and groove, reinforced concrete, culvert pipe, constructed on a reinforced concrete cradle (Type II) base with an unreinforced joint block at the point where the invert slope changes; two 6.5 foot by 12.0 foot reinforced concrete anti-seep collars were also constructed. Although there was no internal inspection of the conduit, it is assumed that all is functioning as it should; nothing to the contrary could be observed.

The spillway flow outlets from the conduit, dropping approximately eight inches into the stilling pool, before continuing into the downstream channel. The pool edge seems to be sloughing off due either to livestock activity or erosion, or both (Photo 7).

(2) Emergency Spillway

The emergency spillway conveys excess water flows beyond the toe of the dam through a grassed open channel (Photo 9). Although the spillway has never been needed during the life of the dam, it appears to be in good shape for the most part. The left side of the spillway channel was constructed with embankment fill material which looks to be in stable condition except for a large slough area observed at the end of the constructed channel (Photo 10). After conveying the excess flows past the dam, the emergency channel turns towards the downstream channel. At this point the emergency channel continues as a rough cut or eroded gully which is filled with trash and brush (Photo 11).

The soils in the emergency spillway channel appear to be silty clay. The channel has a good cover of grass. However, the spillway channel may be subject to erosion due to high velocity flows through the spillway during a large flood.

(3) Outlet Works

There were no regulated outlet works or low level drain pipes constructed in this dam.

e. Reservoir Area

The reservoir water surface elevation at the time of inspection was 709.5 feet above M.S.L.

The surface area of the reservoir at normal water level is about 3-1/2 acres. The rim seems to be stable as no severe erosive areas were observed. The land around the reservoir slopes gently to the rim and is grass and/or tree covered. There are no homes built in close proximity to the reservoir (Photo 8).

f. Downstream Channel

The downstream channel is well defined. The channel has a bottom width of about 5 feet and has a side slope of 1V to 1H on the right side and a side slope of 1V to 2H on the left side. The channel is approximately 3 feet deep. Some trees were observed growing on the channel, however, the trees will not significantly affect the hydraulic efficiency of the channel (Photo 12).

3.2 Evaluation

The visual inspection uncovered nothing of a consequential nature which would require immediate remedial action. However, some conditions were observed which could adversely affect the dam in the future and these should be corrected within a reasonable period of time.

1. There are two larger sized bushes presently growing on the downstream slope plus numerous smaller (approximately 8 inches) bush type plants (perhaps of the same variety as the larger). It does not seem likely that there is any present threat to the safety of the dam from this plant growth, however, the slope should generally be kept clear of all larger plant growth (Photo 5).

2. There seems to be a surplus of old brush and logs in and about the principal spillway inlet; the trashrack has no horizontal member which would prevent entry of the logs into the drop inlet from the slope side of the trashrack (Photo 4). If these logs were to be washed into the inlet, serious reduction in capacity would likely result.

3. The emergency spillway channel should be maintained in a clean condition; presently, there exists within the latter half of this channel an aggregate amount of brush and trash more or less clogging the channel area at one point. Although this condition does not present a hazard, it could be the cause of some real problems in the event the emergency spillway is required for use in the future. The sloughing of the embankment slope of the emergency channel in this same area has caused a break area in the ground surface where there is no grass protection. This condition could be the beginning of a problem gradually increasing in severity in this area (Photos 10 and 11).

4. Another potential problem arises from the fact that livestock paths have been worn into the dam on both the upstream and downstream slopes, and the edges of the embankment (both upstream and downstream) at water level are being broken off by the hooves of the stock. Both the broken edges and the worn paths provide excellent conditions for erosive action (Photo 3).

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Gentry Lake Dam was constructed to impound water for flood control as part of the Lost Creek Watershed Protection Project. There are no specific procedures which are followed for the operation of the dam. The water level is controlled by rainfall, runoff, evaporation and the elevation of the principal spillway.

4.2 Maintenance of Dam

The dam is maintained by the owner, Mr. Moebius Gentry. The dam crest and slopes are kept clear of trees, bushes and weeds. However, two larger sized bushes were observed growing on the downstream slope of the embankment. Mr. Gentry also cleans and removes the debris from the trashrack at the drop inlet. There have not been any repairs done to the dam since its original construction.

4.3 Maintenance of Operating Facilities

The only facility at the damsite which requires maintenance is the trashrack of the drop inlet structure. Debris must be periodically removed from the trashrack. There are no outlet works at this dam.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any warning system in use at the dam site.

4.5 Evaluation

The maintenance at Gentry Lake Dam appears to be adequate, however, the remedial measures described in Section 7 should be undertaken to improve the condition of the dam.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The watershed area of the Gentry Lake Dam upstream from the dam axis consists of approximately 183 acres. The watershed area is mostly wooded with some pasture and range land. Land gradients in the watershed average roughly 5 percent. The Gentry Lake Dam Reservoir is located on an unnamed tributary of the Lost Creek. The reservoir is about 1-1/2 miles upstream from the confluence of the unnamed tributary and the Lost Creek. The watershed is 0.60 mile long. A drainage map showing the watershed and the downstream hazard zone is presented as Plate 1 in Appendix B.

Evaluation of the hydraulic and hydrologic features of Gentry Lake Dam was based upon criteria set forth in the Corps of Engineers' "Engineer Regulation No. 1110-2-106" and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometerological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based upon criteria given in the Corps of Engineers' EM 1110-2-1411 (Standard Project Storm). The Soil Conservation Service (SCS) method was used for deriving the unit hydrograph, utilizing the Corps of Engineers'computer program HEC-1 (Dam Safety Version). The unit hydrograph parameters are

presented in Appendix B. The SCS method also was used for determining the loss rate. The hydrologic soil group of the watershed was determined by use of published soil maps. The hydrologic soil group of the watershed and the SCS curve number are presented in Appendix B. The curve number, unit hydrograph parameters, the PMP index rainfall and the percentages for various durations were directly input to the HEC-1 (Dam Safety Version) computer program to obtain the PMF hydrograph. The computed peak inflow of the PMF and one-half of the PMF are 3,919 cfs and 1,960 cfs, respectively.

Both the PMF and one-half of the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method also utilizing the HEC-1 (Dam Safety Version) computer program. A storm of 50 percent and 25 percent PMF, respectively, preceded the PMF and 50 percent PMF by four days. The reservoir was assumed at the mean annual high water level at the beginning of the antecedent storm. The mean annual high water level for Gentry Lake was estimated to be at the crest of the principal spillway. The antecedent 50 percent PMF storm, when routed through the reservoir, will leave the reservoir at approximately the same elevation as the crest of the principal spillway (See Appendix B) at the end of the the four day period. Thus the reservoir was assumed at the crest level of the principal spillway at the start of the routing computation for PMF, one-half of the PMF and other PMF ratio floods. The peak outflow discharges for the PMF and one-half of the PMF are 2,789 and 1,135 cfs, respectively. Only the PMF when routed through the reservoir resulted in overtopping of the dam.

The size of physical features utilized to develop the stage-outflow relation for the spillway and overtopping of the dam were prepared from field notes and sketches prepared

during the field inspection and available "As-built" drawings obtained from the Soil Conservation Service. The reservoir elevation-capacity data were taken from Soil Conservation Service hydrologic design data for the dam. The stage capacity data were extended by using the U.S.G.S. Luckett Ridge, Missouri Quadrangle topographic map (7.5 minute series). The spillway and dam overtop-rating curve and the reservoir-elevation-capacity curve are presented as Plates 2 & 3, respectively, in Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam must aim at avoiding overtopping. Overtopping is especially dangerous for an earth dam because of its erodable characteristics. The safe hydrologic design of an embankment dam requires a spillway discharge capability combined with an embankment crest height that can handle a very large and exceedingly rare flood without overtopping.

The Corps of Engineers designs dams to safely pass the Probable Maximum Flood that could be generated from the dam's watershed. This is generally the accepted criterion for major dams throughout the world and is the standard for dam safety where overtopping would pose any threat to human life. Accordingly, the hydrologic requirement for safety for this dam is the capability to pass the Probable Maximum Flood without overtopping.

b. Experience Data

It is believed that records of reservoir stage or spillway discharge are not maintained for this site. However, according to the owner, the maximum reservoir level was about 6-1/2 feet above the crest of the principal spillway.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1d and evaluated in Section 3.2.

d. Overtopping Potential

As indicated in Section 5.1.a, only the Probable Maximum Flood when routed through the reservoir, resulted in overtopping of the dam. The peak outflow discharges for the PMF and one-half of the PMF are 2,789 and 1,135 cfs, respectively. The maximum capacity of the spillway just before overtopping the dam is 1985 cfs. The PMF overtopped the dam by half a foot. The total duration of overflow over the dam is 20 minutes during the occurrence of the PMF. The spillway/reservoir system of Gentry Lake Dam is capable of accommodating a flood equal to approximately 80 percent of the PMF just before overtopping the dam. The reservoir/spillway system of Gentry Lake Dam will accommodate the one percent chance flood without overtopping.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. The estimated damage zone extends approximately four miles downstream of the dam. Within the damage zone are four dwellings, five buildings, three barns, one quarry scale house and another dam (MO 10972).

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There were no signs of settlements, misalignments, cracking or other types of distress observed on any part of the embankment or foundation during the visual inspection. The top of dam shows no signs of use by any kinds of vehicular traffic; it is covered with a grass vegetation as are both the upstream and the downstream slopes (Photo 1). Some method of preventing livestock from entering the embankment area would probably have a constructive effect on the surface condition of the dam. Although stock animals have done nothing as yet to seriously affect the dam, their continued trampling can have nothing but overall negative effects.

As far as could be observed, the spillway conduit, the intake, and the outlet area and pool seem to be in a structurally sound condition. Also, the portion of the emergency spillway in the vicinity of the dam embankment was observed to be in good condition. It was mentioned by Mr. Gentry, however, that the emergency spillway has never been used during the life of the dam.

b. Design and Construction Data

Some design assumptions and hydrologic and hydraulic analyses from the project records were made available and these are included in the report (Plates 4 to 15). However, seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. Embankment and foundation soil parameters, construction test result data, and specifications relating to the degree of embankment compaction were not available for use in a stability analysis.

The "As-Built" drawings mentioned in paragraph 2.1 aided in ascertaining an evaluation of the structural components of the dam and appurtenances. They helped to verify the correctness of measurements, to show location of bedrock, to determine whether or not certain concrete members were reinforced, to give an idea of the quantities involved, and to show the overall method of construction used. Field measurements taken were in general agreement with the "As-Built" plans, although there were some minor disagreements; e.g. the top thickness was measured as 14 feet vs. 13 feet on the plans; "As-Built" drawings show the settled top of dam elevation as 723.3 feet above M.S.L. whereas, the field measurements result in an elevation of 724.5 feet above M.S.L. (assuming as correct the "As-Built" elevation for the drop inlet rim). From a review of the "As-Built" drawings for Gentry Lake Dam, coupled with an on-site inspection, the dam and appurtenant structures appear to be structurally sound.

c. Operating Records

No operating records were available relating to the stability of the dam or appurtenant structures. The water level on the day of the visual inspection was approximately one-half inch more or less above the intake, which was 15 feet below the top of dam. This is considered to be the normal operating level; however, the water has apparently been from four to six feet above the intake level at its highest point in recent years according to Mr. Gentry. The reservoir would normally be controlled at the level or the crest of the overflow pipe. The dam apparently has never seeped.

d. Post Construction Changes

No post construction changes were in evidence nor did the owner remember any having taken place.

e. Seismic Stability

The dam is located in Seismic Zone 2 (Plate 18), as defined in "Recommended Guidelines For Safety Inspection of Dams" as prepared by the Corps of Engineers, and will not require a seismic stability analysis. An earthquake of the magnitude which would be expected in Seismic Zone 2 should not cause significant distress to a well designed and constructed earth dam. Available literature indicates that no active faults exist near the vicinity of the damsite.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based upon observations of field conditions at the time of inspection along with data available to the inspection team.

It is also important to note that the condition of a dam depends upon numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be assurance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Gentry Lake Dam is found to be "Inadequate". The spillway/reservoir system will accommodate approximately 80 percent of the PMF without overtopping the dam. The surface soils in the embankment and the emergency spillway appears to be silty clay. The emergency spillway and the dam embankment have a good cover of grass. The dam is overtopped by half a foot during the occurrence of the PMF. The maximum velocity of flow in the

emergency spillway during PMF will be about 10 ft/sec. The emergency spillway channel may be subject to erosion due to high velocity of flow during the PMF. The dam may also be susceptible to erosion due to high velocity of flow on its downstream slope, due to overtopping of the dam during the PMF. However, it is possible that no significant degradation of the dam crest or the spillway will occur due to short duration of overtopping (20 minutes) and short duration of high velocity flow (approximately 3-1/2 hours over 7 ft/sec during PMF) through the spillway.

A quantitative evaluation of the safety of the embankment could not be made in view of the absence of seepage and stability analyses. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions and made a matter of record. The present embankment and appurtenant structures, however, reportedly have performed satisfactorily since their construction; there have been no failures or evidence of instability. Reportedly, the dam has never been overtopped and no evidence indicating the contrary was observed.

b. Adequacy of Information

The conclusions presented in this report are based upon field measurement, past performance and the present condition of the dam. Some information on the design hydrology and hydraulic design of the dam was available, and this information was considered good, and hydrologic and hydraulic data from this information were used for Phase I hydrologic and hydraulic evaluation of the dam. However, seepage and

stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency

The remedial measures recommended in Paragraph 7.2 should be accomplished within a reasonable period of time, and the item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II Inspection

Based upon results of the Phase I inspection, and if the remedial measures recommended in Paragraph 7.2 are undertaken, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

a. Alternatives

Spillway capacity should be increased to pass the PMF without overtopping the dam.

b. O & M Procedures

1. The two larger sized bush plants on the downstream slope should be removed and prevented from continued growth. Other bushes of smaller size should be prevented from excessive growth.

2. Any logs and brush behind and inside the principal spillway inlet should be removed.

3. Brush and trash should be removed from the downstream half of the emergency spillway channel.

4. Deterioration of erodible areas in the vicinities of the emergency spillway channel, the livestock paths, and edges of the embankment (both upstream and downstream), should be checked and repaired.

5. Some action should be taken in order to prevent livestock from any continued activity on the dam embankment.

6. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of earth dams.

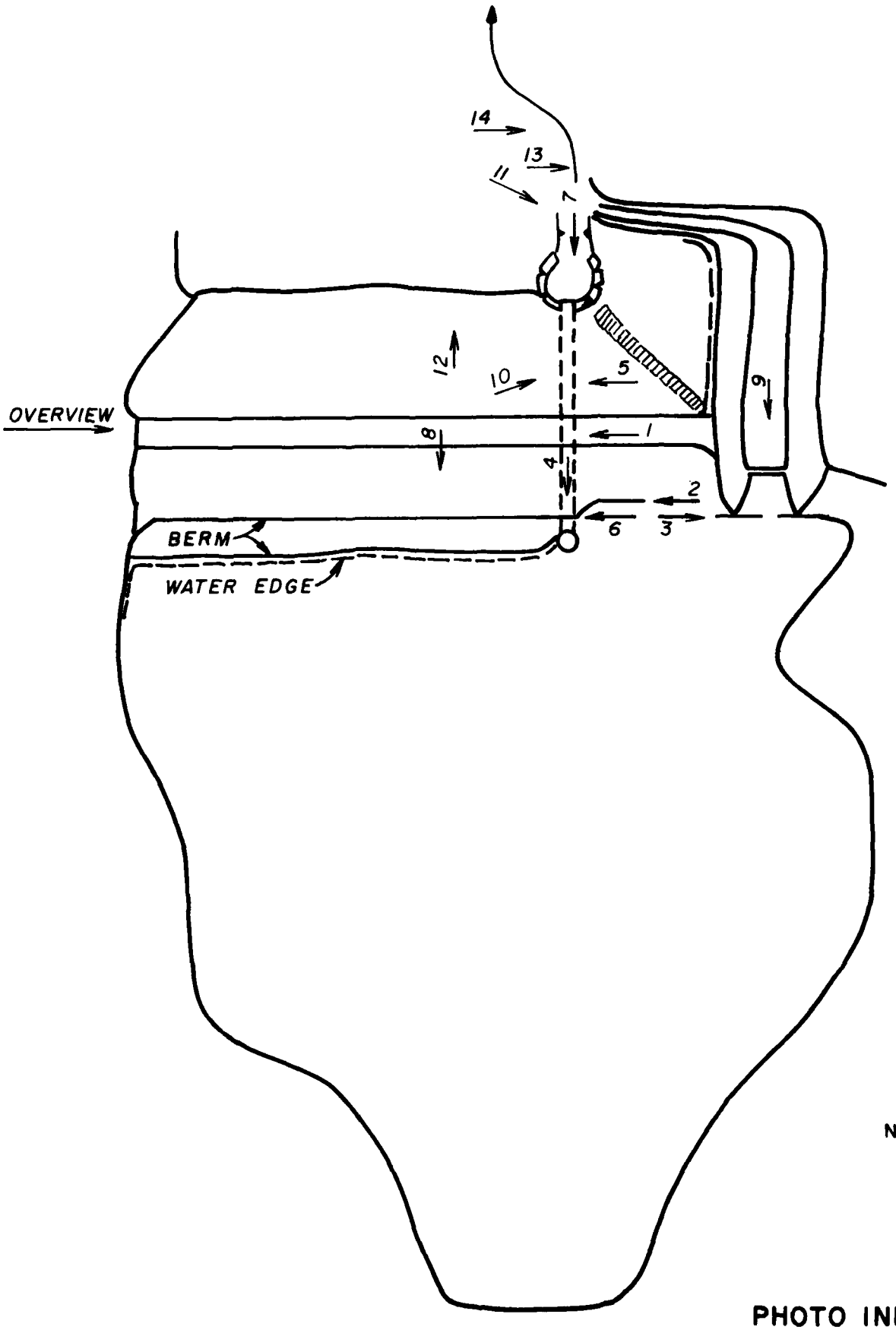
7. The owner should initiate the following programs:

   (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earthen dams.

   (b) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION



NO SCALE

PHOTO INDEX
FOR
GENTRY LAKE DAM

Gentry Lake Dam

Photographs

Photo 1 - Top of dam showing left abutment contacts and entry from street.

Photo 2 - Upstream slope showing livestock trails and principal spillway.

Photo 3 - View of berm breakoff area and livestock paths in vicinity of right abutment upstream contact.

Photo 4 - View from rear of spillway trashrack showing logs and lack of horizontal bar.

Photo 5 - Downstream slope displaying large plant growth and more livestock trails.

Photo 6 - View of principal spillway morning glory inlet with antivortex wall and trashrack.

Photo 7 - View of spillway outlet and stilling pool showing top of dam, stock trails, and erosive areas in pool edge.

Photo 8 - View of reservoir and rim area taken from dam.

Photo 9 - Inlet area of emergency spillway.

Photo 10 - View of right abutment downstream solope, livestock trails, emergency spillway embankment, and sloughed earth in vicinity of emergency spillway outlet.

Photo 11 - Brush and trash in outlet channel of emergency spillway and slough area.

Photo 12 - Overview of downstream channel area of Lost Creek tributary.

Photo 13 - Downstream channel outcrop of Ordovician Maquoketa shale bedrock.

Photo 14 - Same as Photo 11, but further downstream.

Photo 1

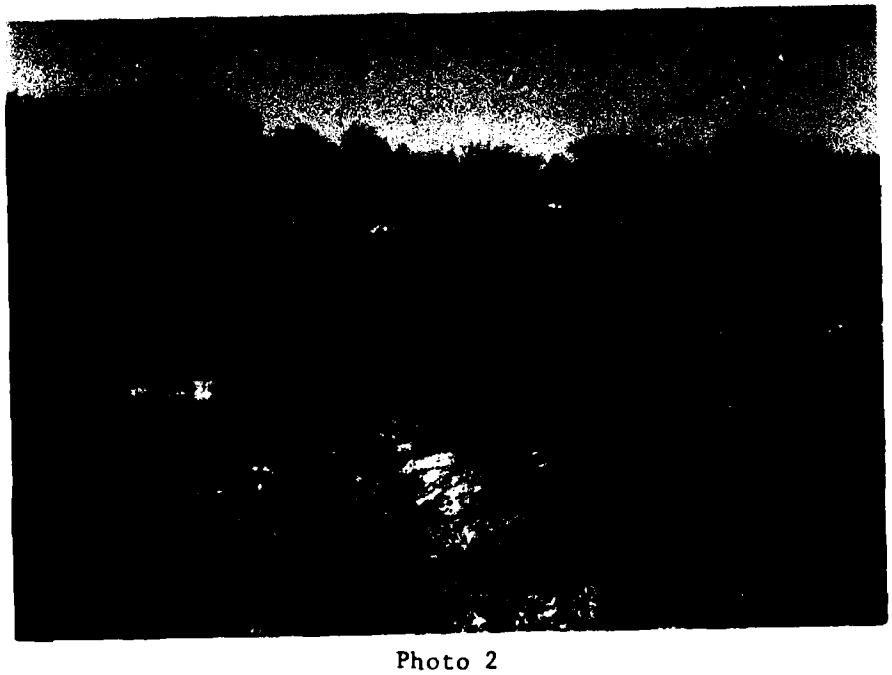


Photo 2

Photo 3

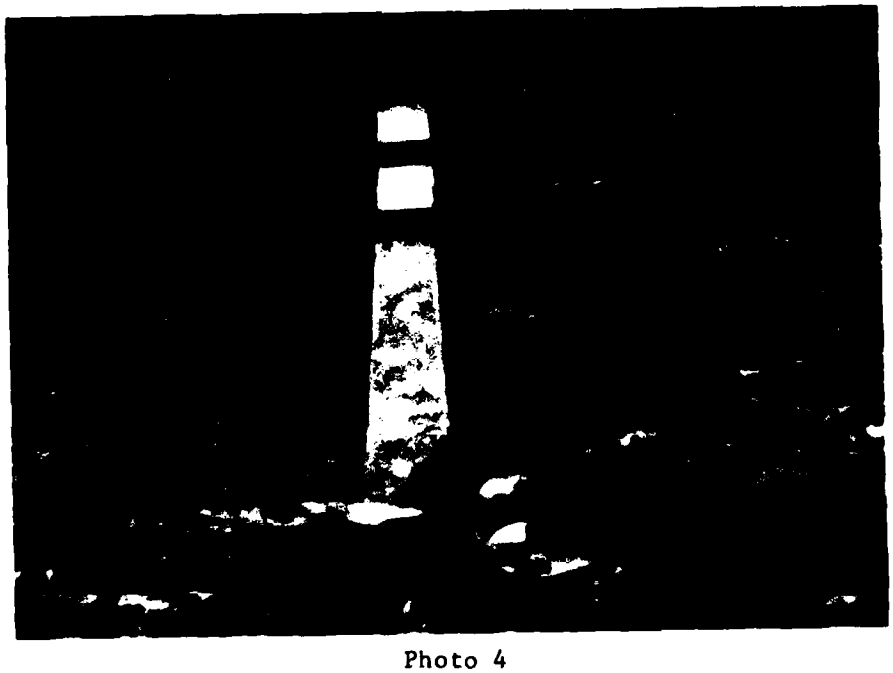


Photo 4

Photo 5

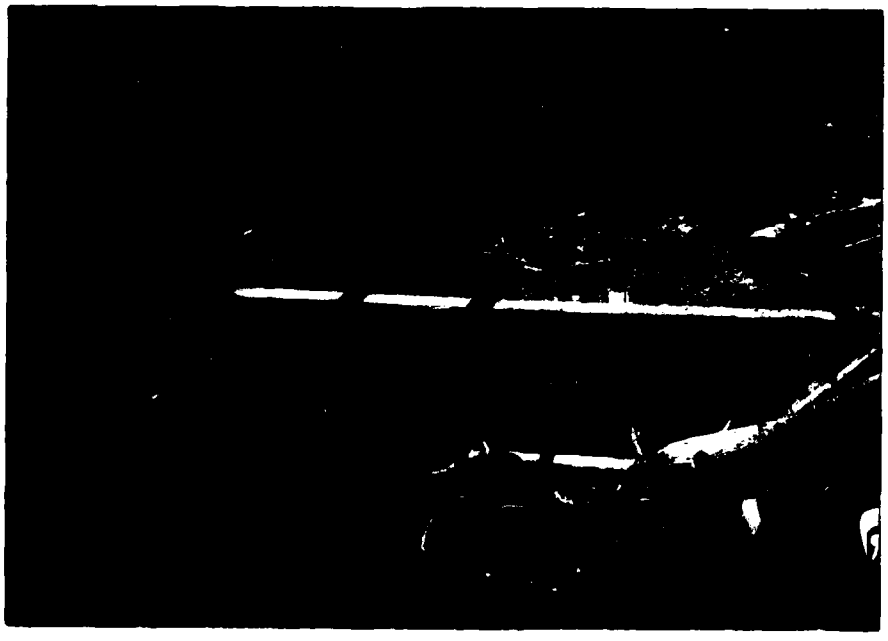


Photo 6

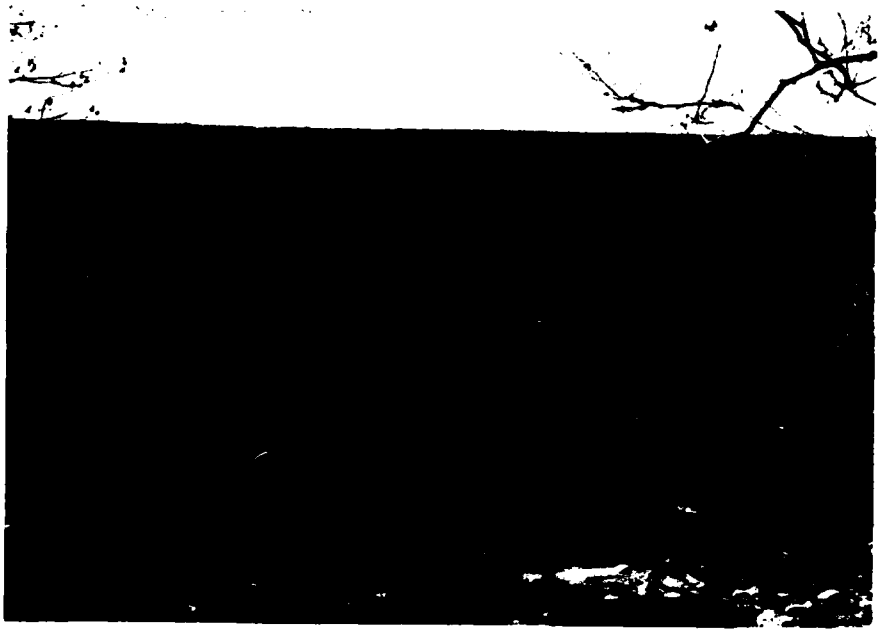


Photo 7

Photo 8

Photo 9

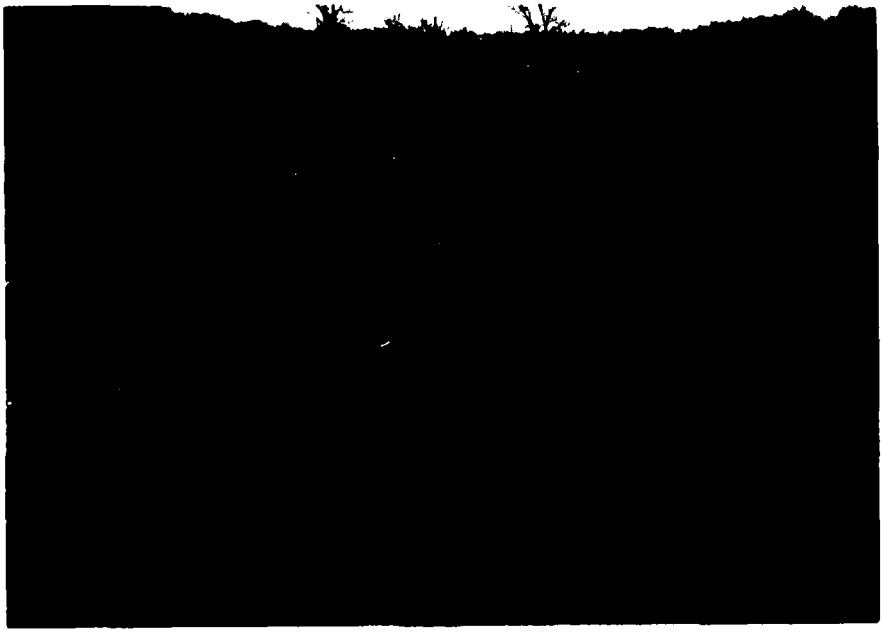


Photo 10

Photo 11

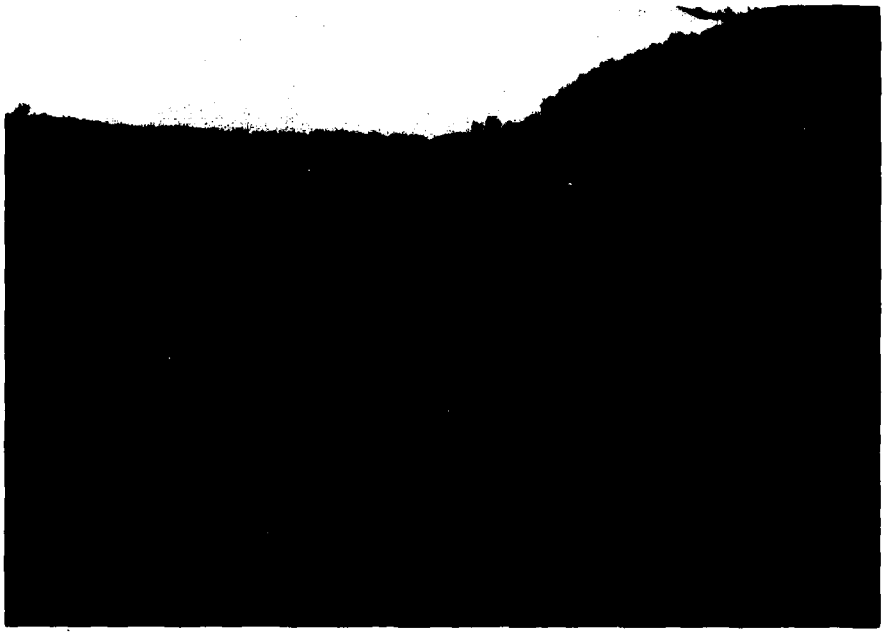


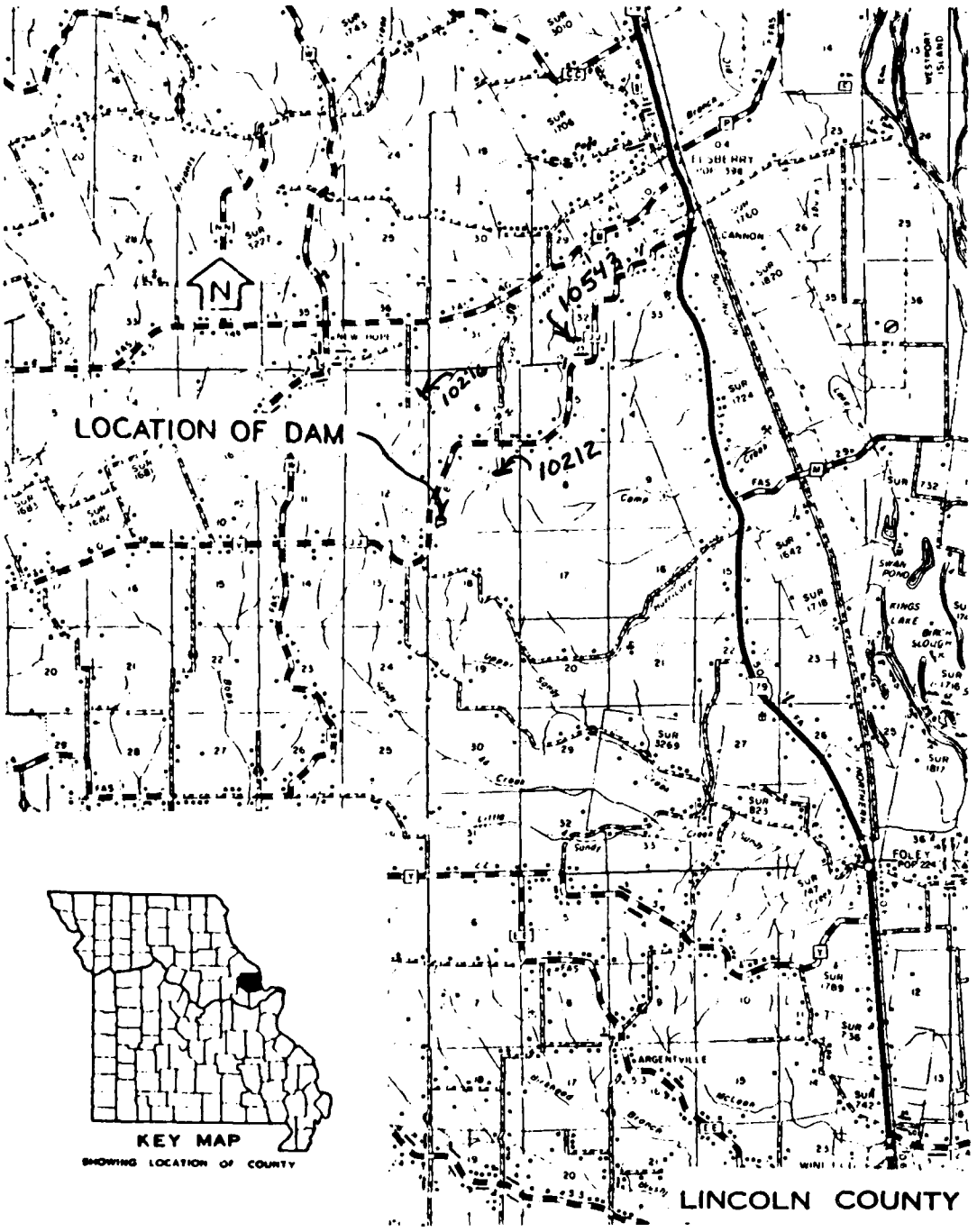
Photo 12

Photo 13

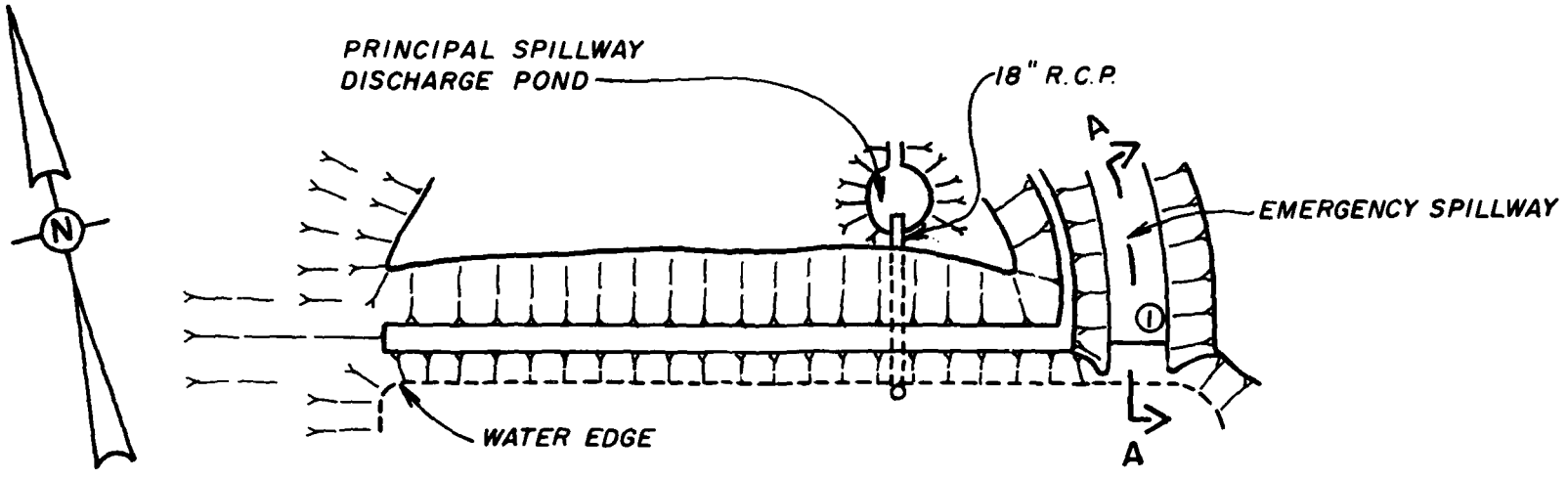
Photo 14

PLATES

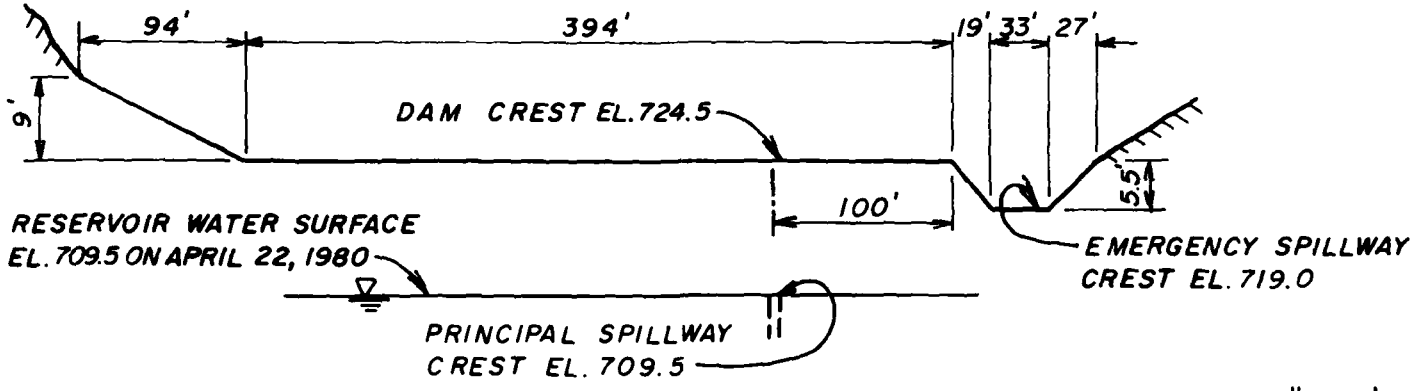
PLATE 1



LOCATION MAP - GENTRY LAKE DAM



PLAN



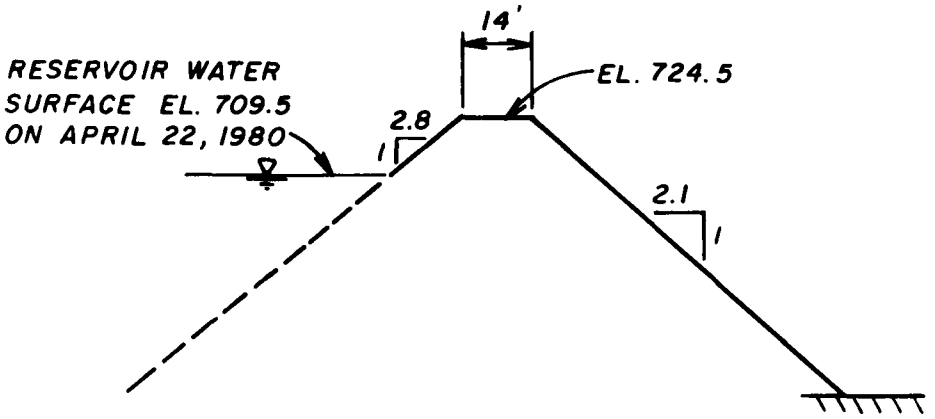
ELEVATION

SCALE: 1" = 100' HORIZ
1" = 20' VERT.

GENTRY LAKE DAM
PLAN AND PROFILE

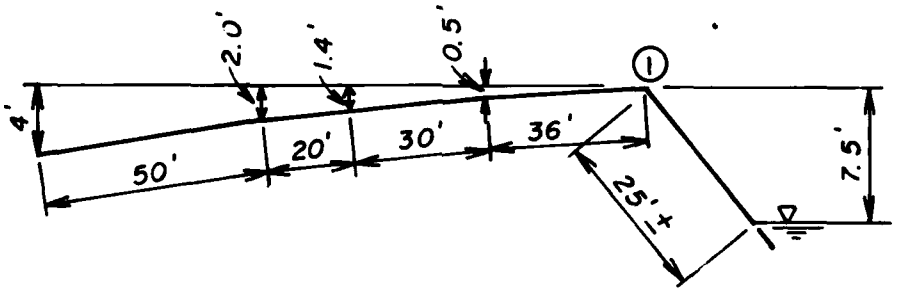
PLATE 2

PLATE 3



MAXIMUM SECTION

SCALE: 1" = 40' HORIZ.
1" = 20' VERT.



SCALE: 1" = 40' HORIZ.
1" = 10' VERT.

SPILLWAY PROFILE
SECTION A-A

GENTRY LAKE DAM
SECTION OF EMBANKMENT &
SPILLWAY PROFILE

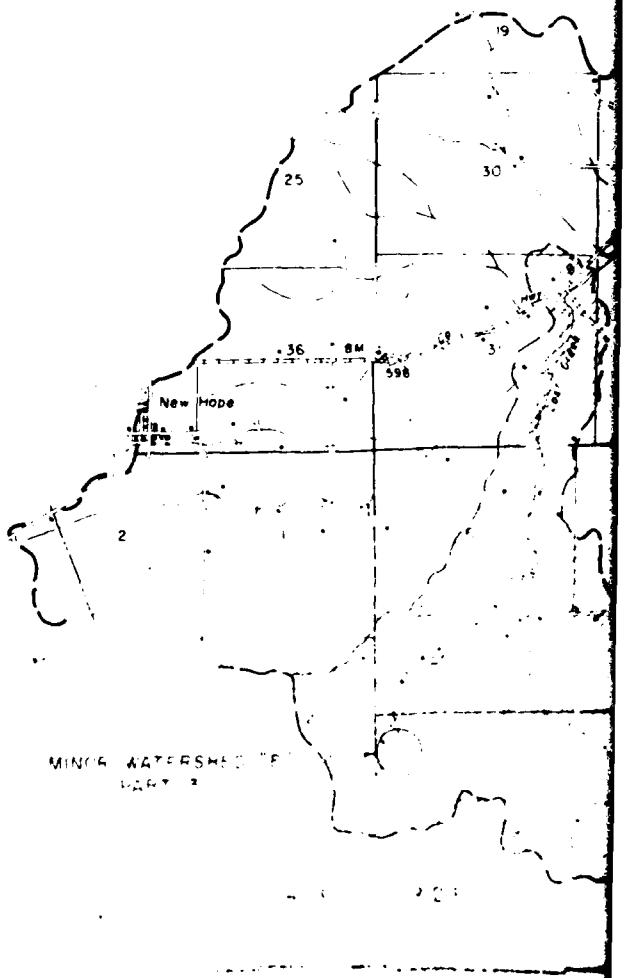
U. S. DEPARTMENT OF AGRI
SOIL CONSERVATION SE

DETAIL PLANS

LOST CREEK WATERSHED PRO

THE SOIL DISTRICT OF LINCOLN COU

PART 3 OF MINOR WAT



APPROVED BY

APPROVED BY

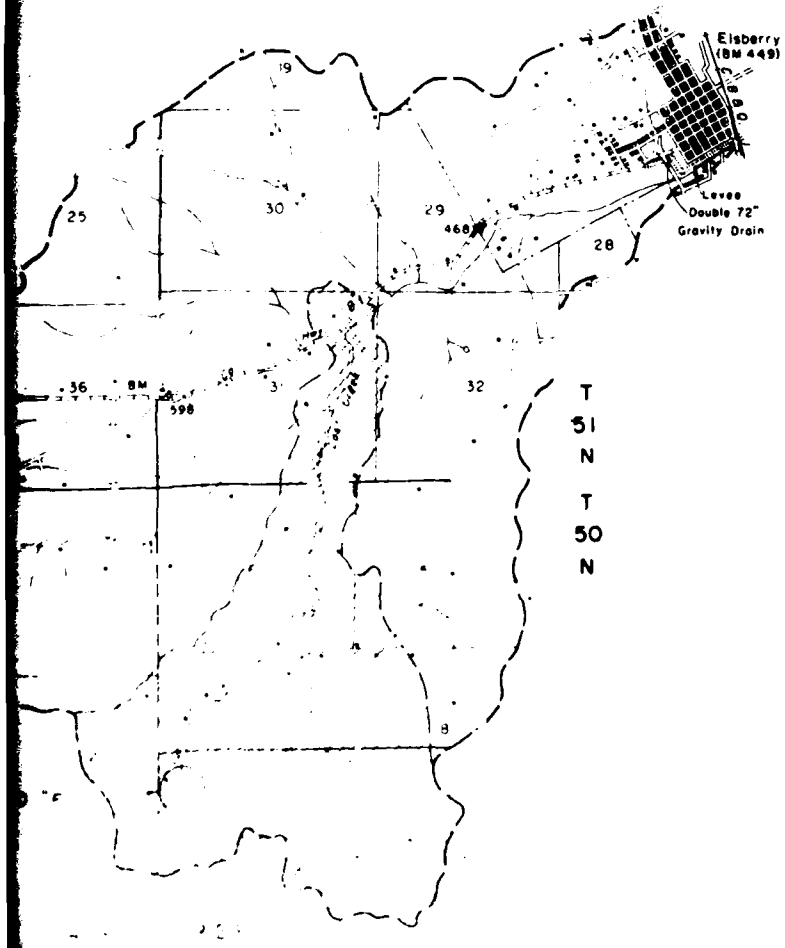
PLATE-4

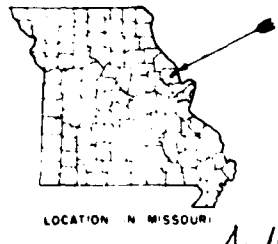
S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAIL PLANS FOR
WATERSHED PROTECTION PROJECT

IL DISTRICT OF LINCOLN COUNTY, MISSOURI

OF MINOR WATERSHED "E"





As built

3-E-45020-P
Sheet 1 of 11

SHEET 1 OF 11

LEGEND

State Line
County Line
Township Line
Section Line
Property Line
Paved Road
Improved Road
Dirt Road
Private or Field Road
Railroad — Active — Abandoned
Base Line
Offset Line
Center Line of Improvements
Watershed Boundary
Sub-Watershed Boundary
Fence
Fence to be Removed
Telephone Line (Location of Pole) T T
Power Line (Location of Pole)
Pipe Line
Water Pipe Line (Farm) Water Line
Existing Tile Line
Proposed Tile Line
Junction Box
Open Ditch (4' deep or over)
Shallow Ditch (Less than 4' deep)
Open Ditch to be Cleaned Out
Terrace, Graded
Terrace, Level
Diversion
Crossed Watercourse
Stream (Large)
Stream (Small)
Intermittent Stream
Stream Disappears on Flat
Stream Disappears in Sink
Marsh
Levee

Building
School
Church
Cemetery
Windmill
Well — Well
Spring
Mine, Quarry, or Gravel Pit
Section Corner
Section Center — 5
Bench Mark, Permanent — ×BM 70
Bench Mark, Temporary — × TBM 71
Control Point, Permanent — AD
Control Point, Temporary — 13
Point on Offset Line
Point of Intersection
Lake or Pond
Intermittent Lake or Pond
Soil Boring — 102
Approximate Limit of Work Area
Fill Lines
Contours — 1240
Gully Banks
Indicated elevation at decimal point
North Arrow
Drop Inlet
Drop Spillway
Box Inlet Drop Spillway
Box Inlet Drop Spillway with Bridge

Dashed lines indicate existing contours or gully banks within areas of excavation and fill.

Chute
Chute with Bridge
Box Inlet Chute
Box Inlet Chute with Bridge
Bridge
Box Inlet Culvert
Culvert
Culvert Extension
Inlet on Culvert
Outlet on Culvert
Sod Flume
Terrace Outlet
Stock Watering System
Embankment Drainage System

SOIL BORIN

LOG

1 Muck
2 Peat
3 Silt Loam
4 Silty Clay Loam
5 Sandy Loam
6 Clay Loam
7 Sandy Clay
8 Clay
9 Sand
10 Fine Gravel
11 Coarse Gravel
12 Slate and Shale
13 Coal seam
14 Sandstone
15 Limestone
16 Glacial drift (impervious)
17 Glacial drift (pervious)
G.W. = Ground Water

1 3 5 7 9

NOTE: These symbols are used primarily on the Work Location Map, where applicable they may be shown on the plans.

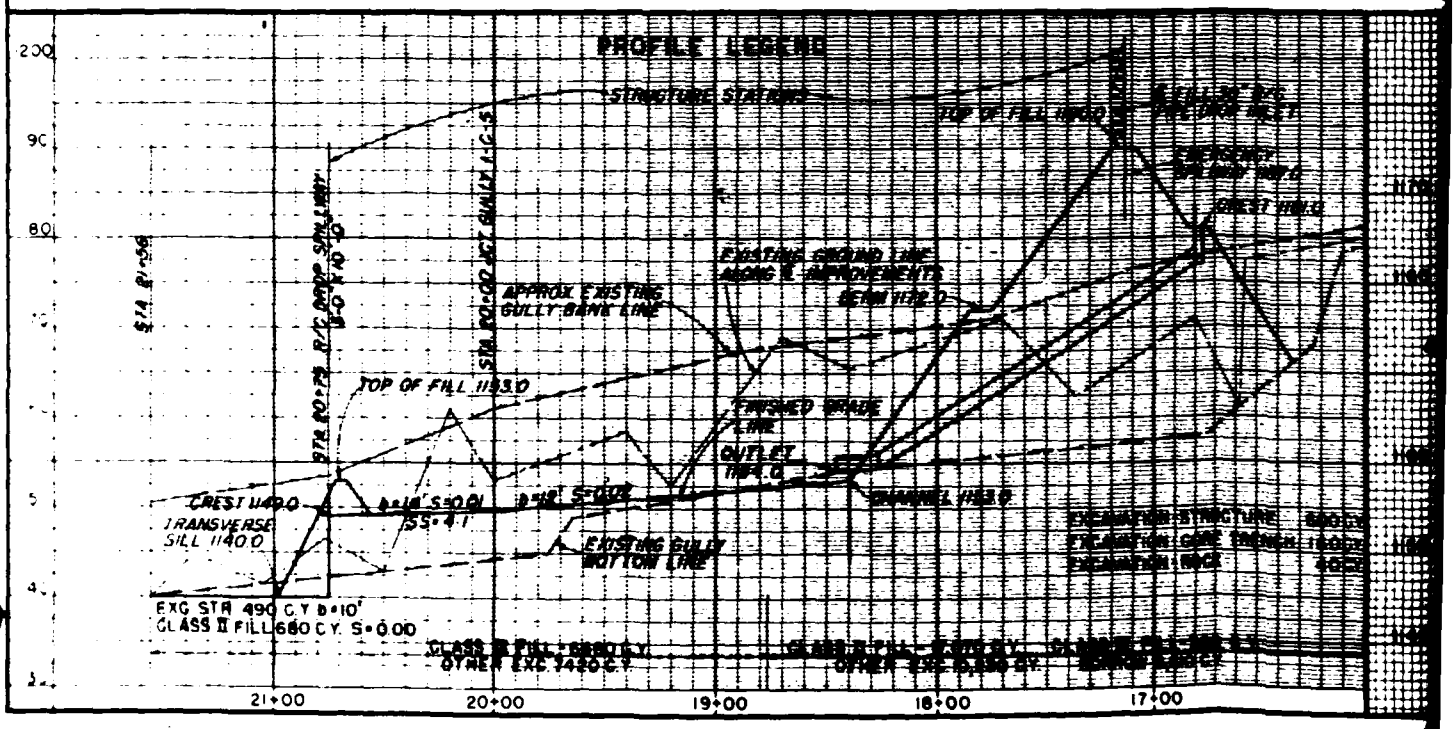


PLATE-5

Chute
Chute with Bridge
Box Inlet Chute
Box Inlet Chute with Bridge
Bridge
Box Inlet Culvert
Culvert
Culvert Extension
Inlet on Culvert
Outlet on Culvert
Sod Flume
Terrace Outlet
Stock Watering System
Embankment Drainage System — Pipe — Pit-Run Gravel

×BM 70
× TBM 71
102

SOIL BORINGS

LOG

1 Muck
2 Peat
3 Silt Loam
4 Silty Clay Loam
5 Sandy Loam
6 Clay Loam
7 Sandy Clay
8 Clay
9 Sand
10 Fine Gravel
11 Coarse Gravel
12 Slate and Shale
13 Coal seam
14 Sandstone
15 Limestone
16 Glacial drift (impervious)
17 Glacial drift (pervious)
G.W. = Ground Water

METHOD No 1

1 3 5 7 9

Using either the description, numerical number or symbol representing the soil type

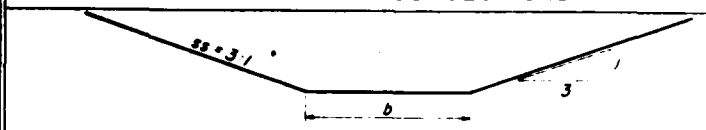
METHOD No. 2

Using Mechanical Analysis
% % % %
gravel - sand - silt - clay

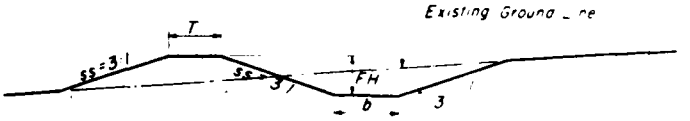
0-18-76-6
0-28-64-8
0-20-66-14

...d primarily on the Work Location ... they may be shown on the plans.

TYPICAL CROSS SECTIONS



IMPROVED DRAINAGEWAYS
CHANNELS, GRADED WATERCOURSES, SOD FLUMES, ETC



DIVERSIONS & EMERGENCY SPILLWAYS

DEFINITIONS OF TERMS

s - Grade of channel in feet of drop per foot of length
b - Bottom width of channel in feet
ss - Side slope ratio, horizontal to vertical
T - Top width of dike, levee or fill in feet
FH - Fill height of dike in feet (vertical distance from bottom of channel ...

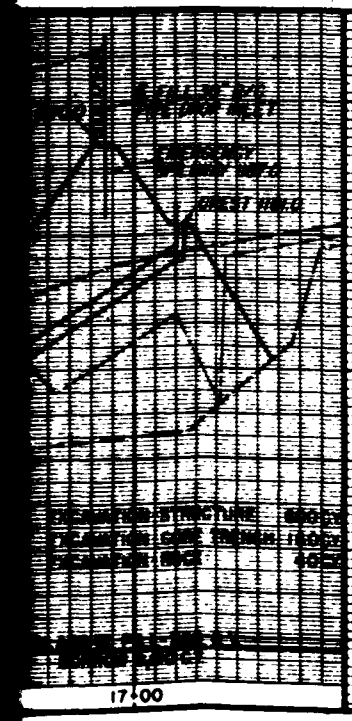
TABLE OF STANDARD DIMENSIONS

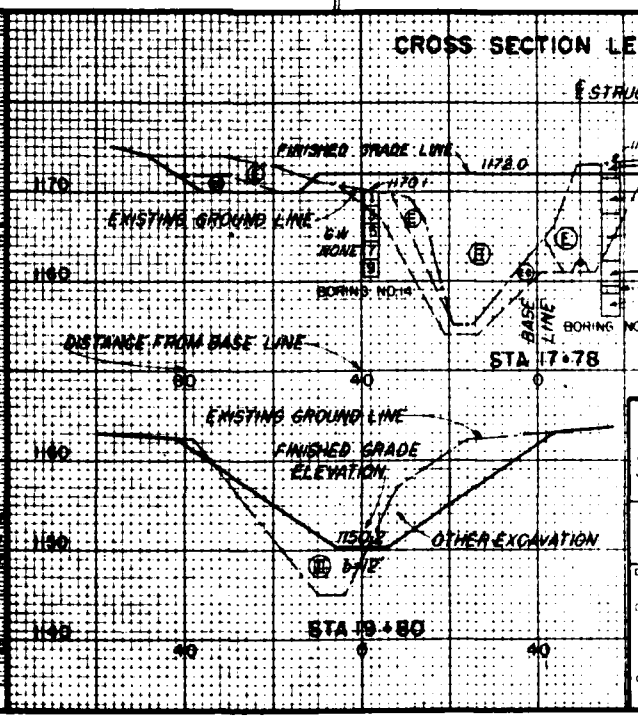
IMPROVEMENT	T	
Improved Drainageways	-	
Diversions	6	
Levees	6	3
Drop Inlet Embankments	0	3
Chute Embankments	6'	3
Drop Spillway Embankments	6	3 / upstream

NOTE
1. Use standard dimensions unless otherwise shown ...
2. Use s, b, and FH as shown on plans

GENERAL NOTES

℄ improvements are along Base Line unless otherwise indicated
Elevations of pipes refer to invert elevations
Cross sections shown as looking downstream
Lines showing limits of structure excavation are on a 1:1 slope unless ...





LEGENDS AND NOTES

Soil Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed
Drawn
Traced
Checked

Sheet 3 of 11
3-F-45, 20-P

Standard Drawing No. ... 15 87 (4 6 55)

2

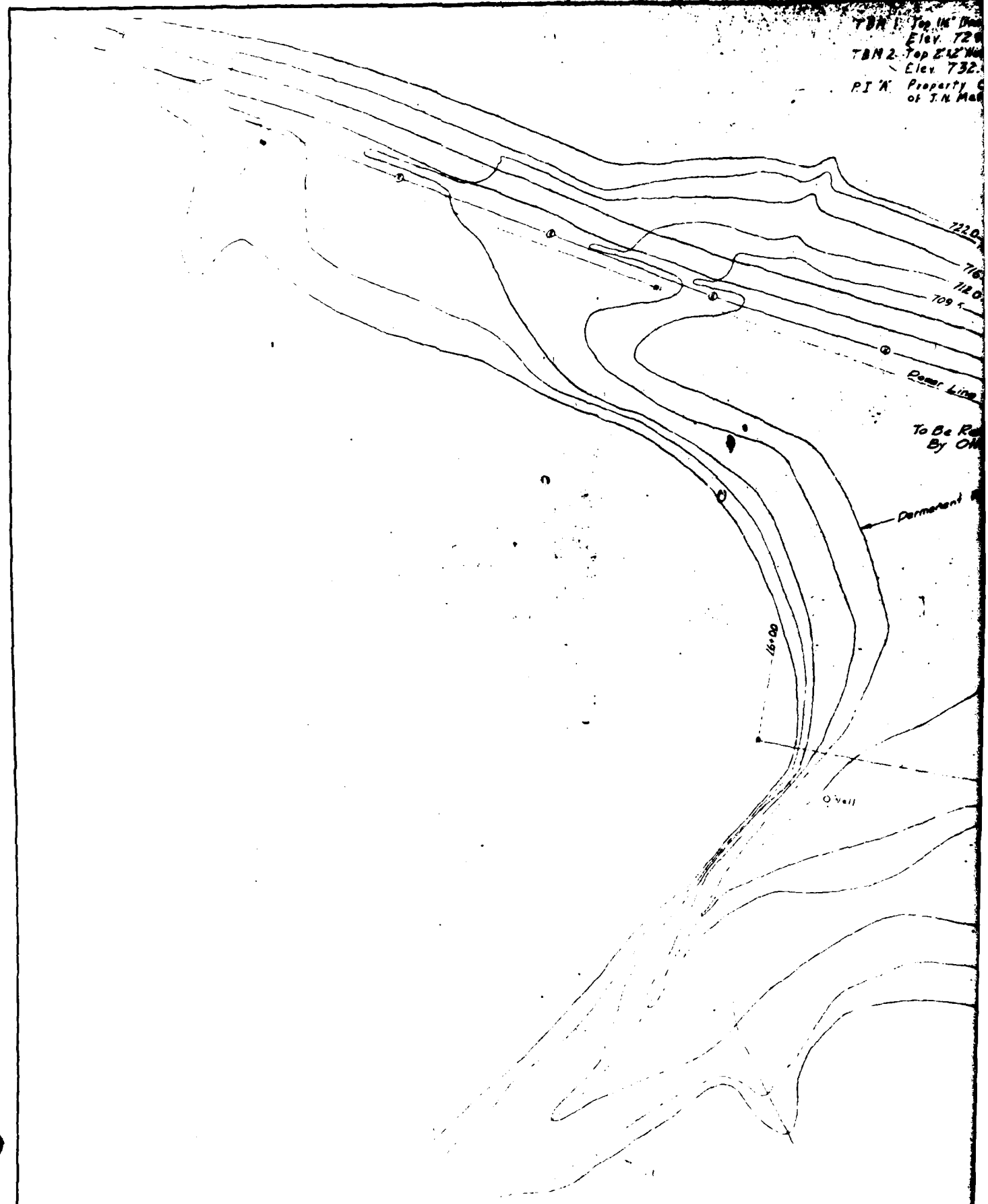
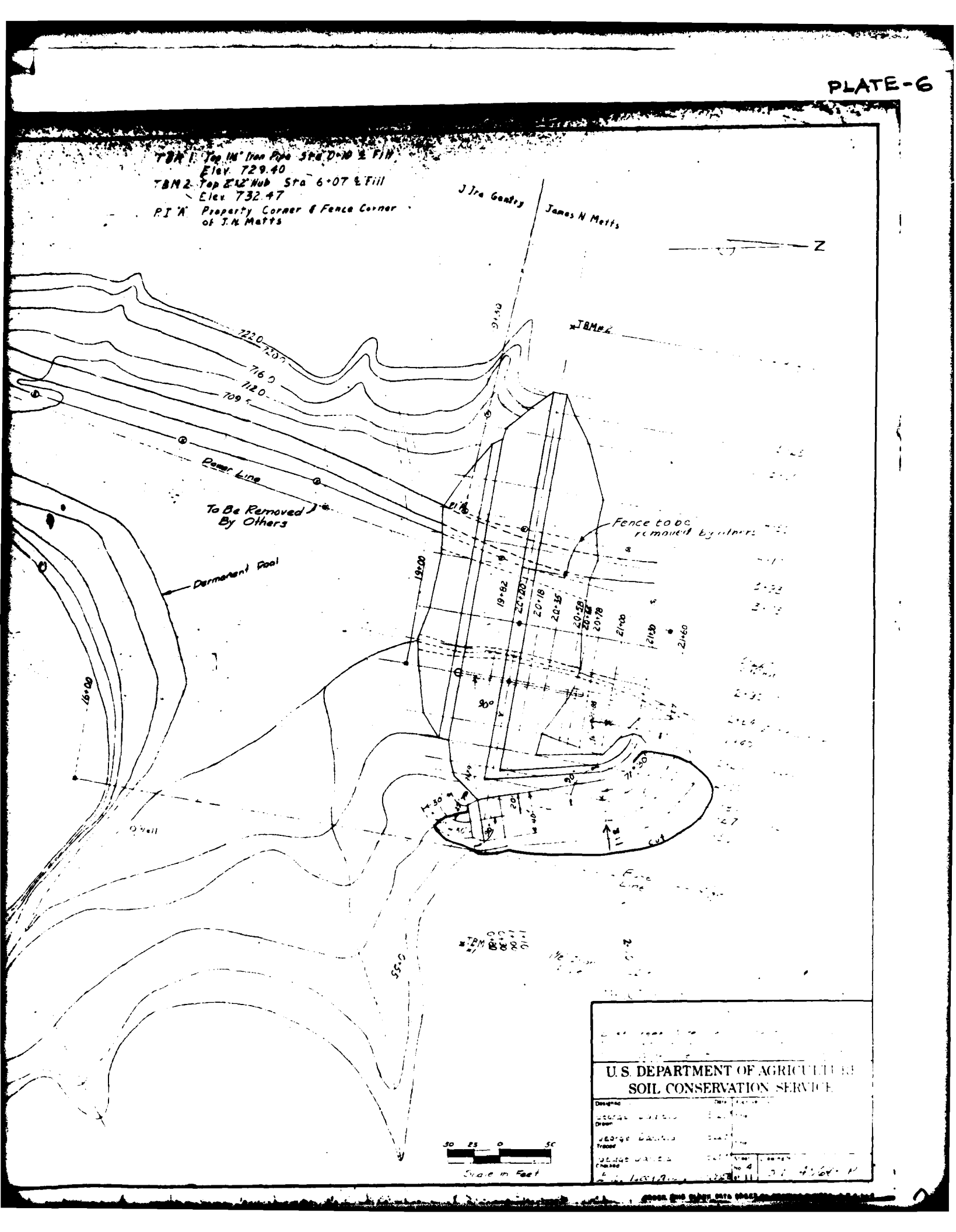

TBM 1. Top
Elev. 72
TBM 2. Top
Elev. 732.
P.I "A" Property
of T.N. Ma
722.0
716
712.0
709
Power Line
To Be R
By O
Permanent
16+00
Oval

PLATE-6


TBM 1 Top 16" Iron Pipe Sta. 0+10 & Fill
Elev. 729.40
TBM 2 Top 8"x2" Nub Sta. 6+07 & Fill
Elev. 732.47
P.I. 'A' Property Corner & Fence Corner of J.N. Matts
J Jra Gentry
James N Matts
Z
TBM 2
722.0
716.0
712.0
709.5
Power Line
To Be Removed By Others
Fence to be removed by others
Permanent Pool
19+00
19+82
20+18
20+35
20+58
20+78
21+00
21+60
16+00
90°
Cut
Fill
Fence Line
TBM 1
Spoil
Scale in Feet
50 25 0 50
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed
Drawn
George Gentry
Traced
George Gentry
Checked
Sheet No. 4

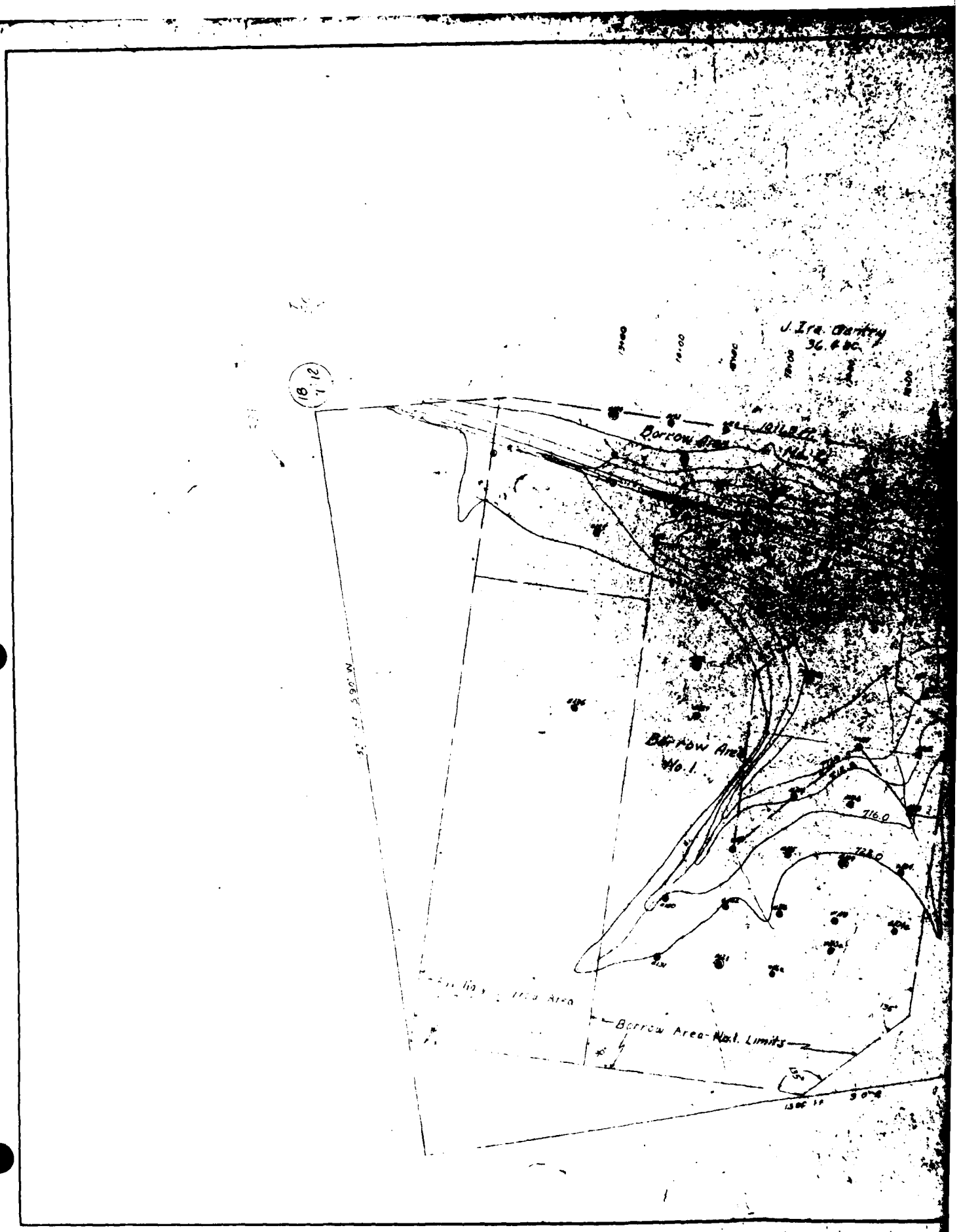
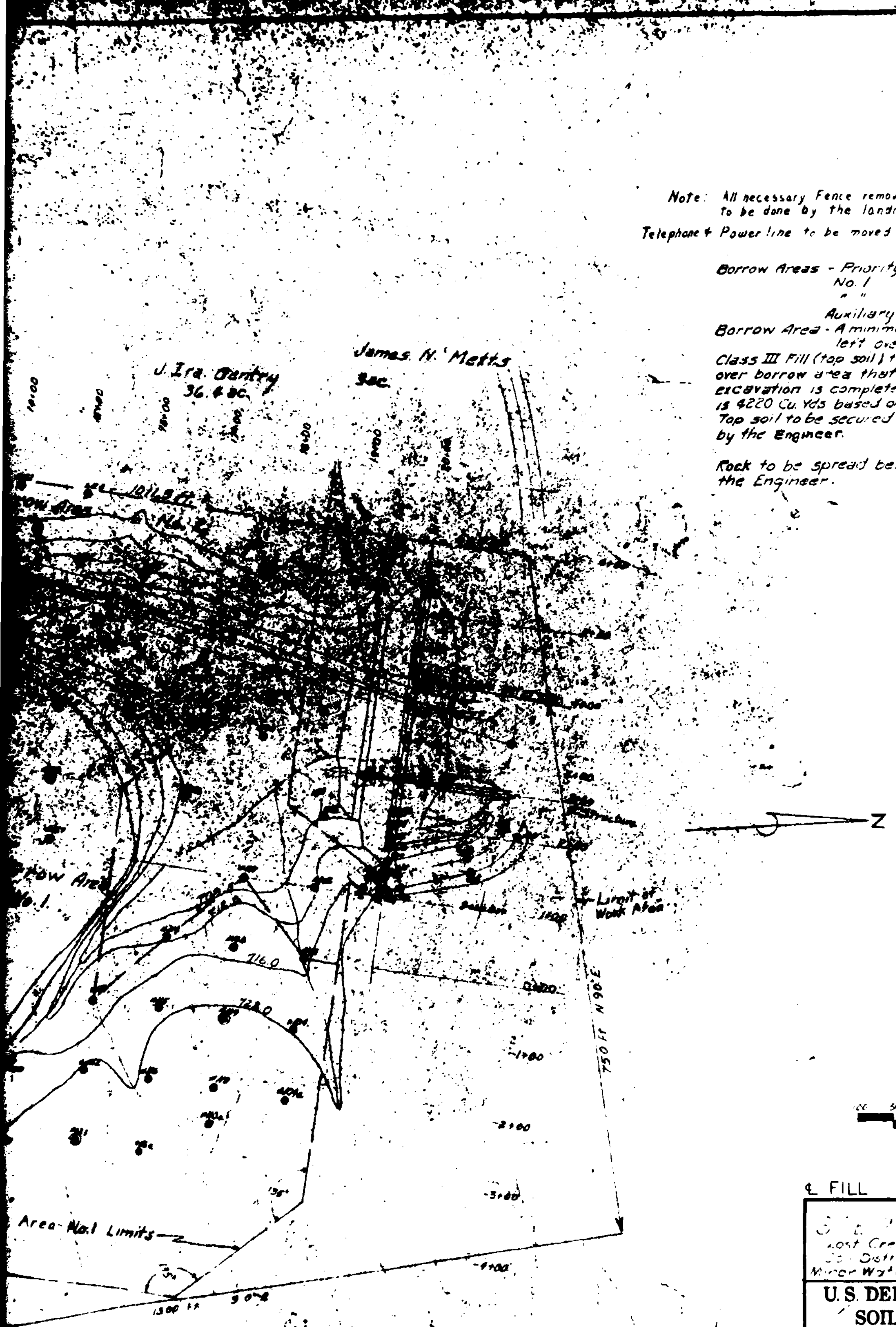

Borrow Area No. 1
716.0
728.0
Borrow Area-Nat. Limits

PLATE-7



Note: All necessary Fence removal and /or replacement to be done by the landowners

Telephone + Power line to be moved by others (REA)

Borrow Areas - Priority of use
No. 1 - First
" " - Second
Auxiliary Borrow - Third

Borrow Area - A minimum of two [illegible] left over rock.

Class III Fill (top soil) to be placed to a depth of [illegible] over borrow area that is above elevation 703.5 [illegible] excavation is completed. Class III Fill required [illegible] is 4220 Cu. Yds based on covering [illegible] Top soil to be secured from [illegible] by the Engineer.

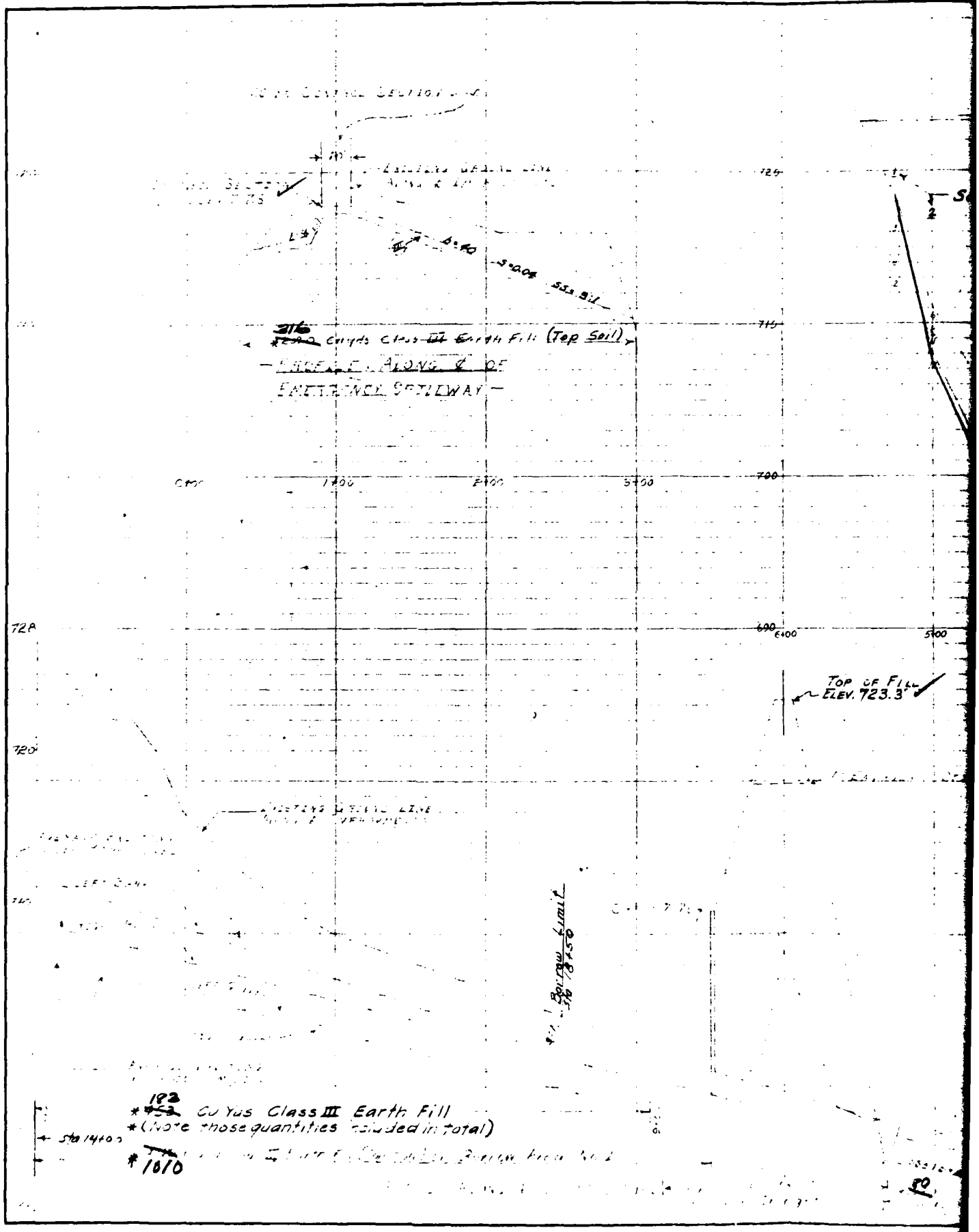
Rock to be spread below Elev. 7[illegible] the Engineer.

℄ FILL STA. [illegible]

Lost Creek Watershed [illegible]
[illegible] District [illegible]
Minor Watershed "E"

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
George Daniels	[illegible]	Title
Drawn		
George Daniels	[illegible]	Title
Traced		
George Daniels	[illegible]	Sheet No. 5 of 11
Checked		Drawing No. 3-E-45[illegible]
E. G. Browning	[illegible]	

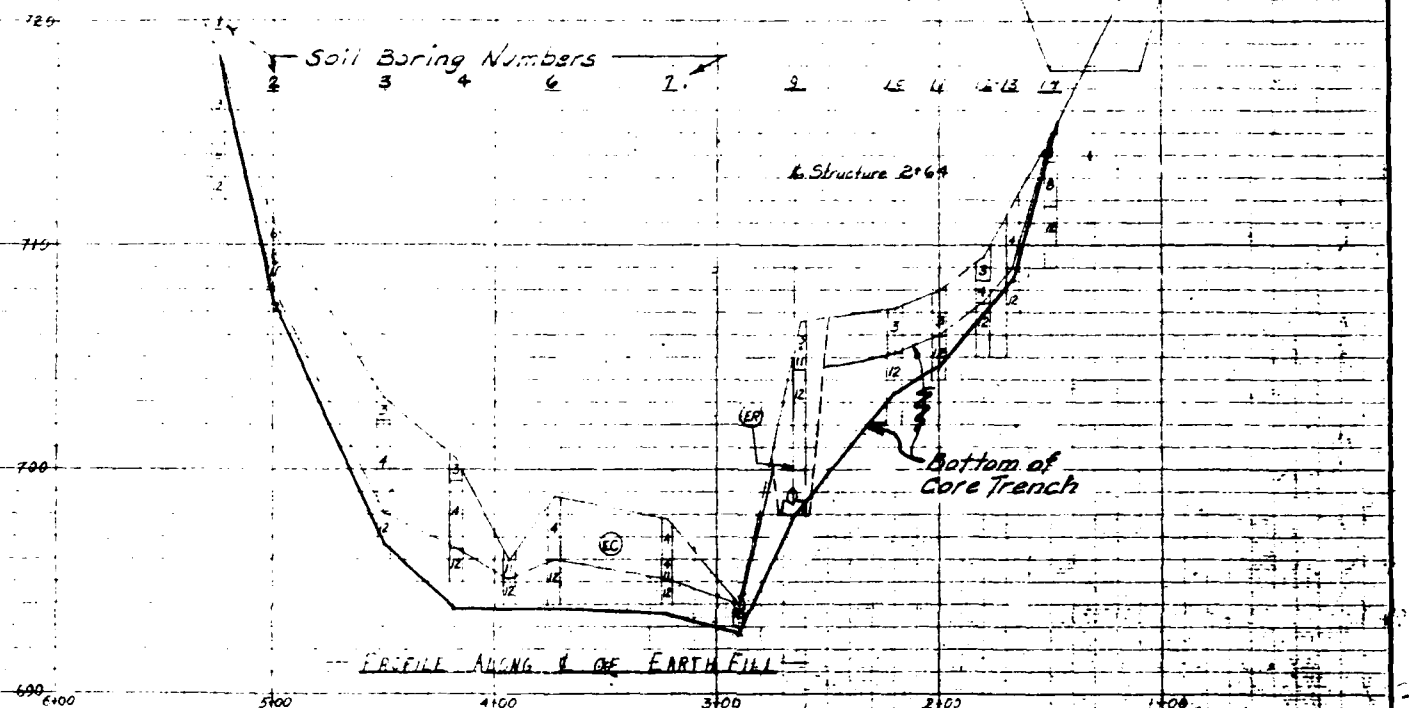


~~316~~ 183 Cu yds Class III Earth Fill (Top Soil)
– PLACED ALONG ℄ OF
EMERGENCY SPILLWAY –

~~316~~ 183 Cu Yds Class III Earth Fill
(Note those quantities included in total)

#1010

PLATE-8



FILL AND EXCAVATION QUANTITIES

FILL

CLASS II	~~22693.0~~ Cu. Yd.	22690 CU YDS.
CLASS III	~~550.0~~ Cu. Yd.	263
CLASS III (Top Soil)	~~1815.0~~ Cu. Yd.	1324

EXCAVATION

STRUCTURE	~~164.0~~ Cu. Yd.	228 CU YDS
CORE	~~4488.0~~ Cu. Yd.	9512 CU YDS
ROCK	~~3066.0~~ Cu. Yd.	0

As built

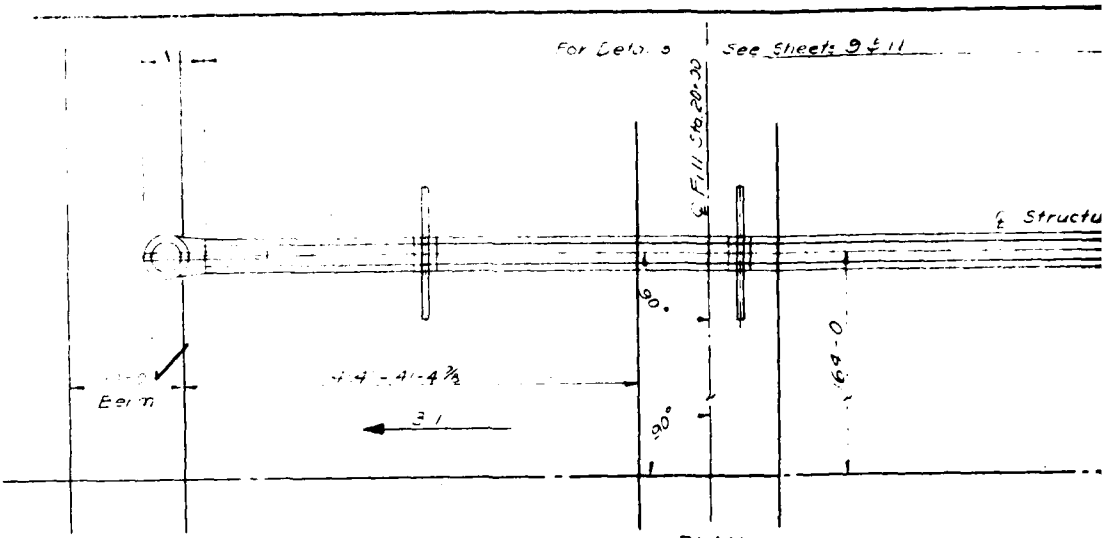
STRUCTURE E-1 ℄ FILL STA. 20+00

PROFILES

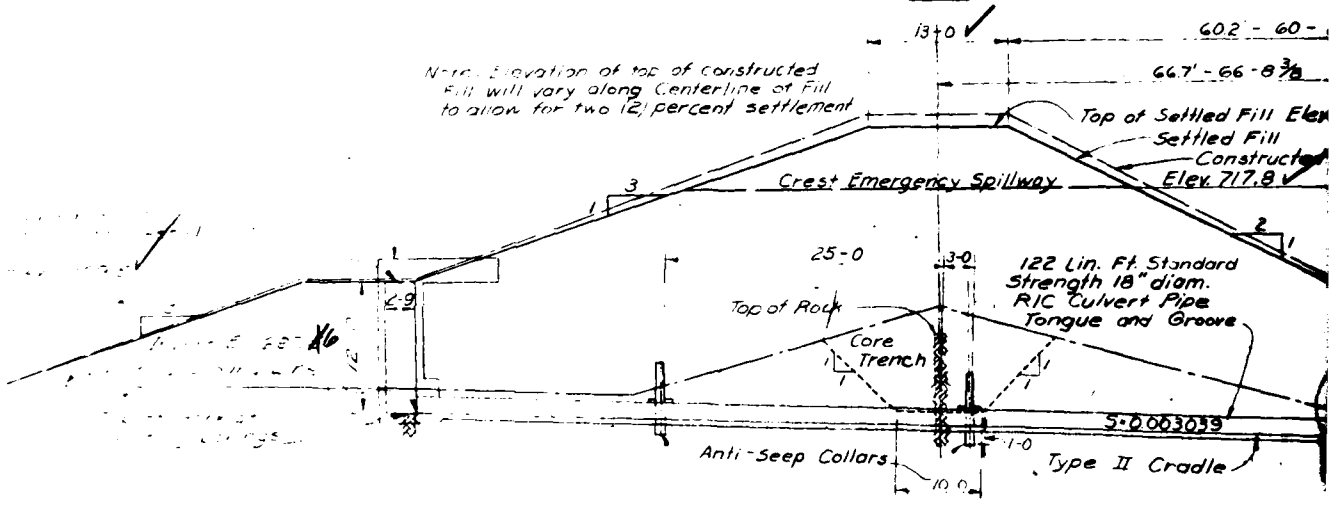
[illegible] Creek Watershed Protection Project
[illegible] County of Lincoln County, Missouri
[illegible] Watershed E Part 3

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed / Date		Approved by	
Drawn		Title	
Traced		Title	
Revised		Sheet No. 6 of 11 sheets	Drawing No. 3-E-4562J-P



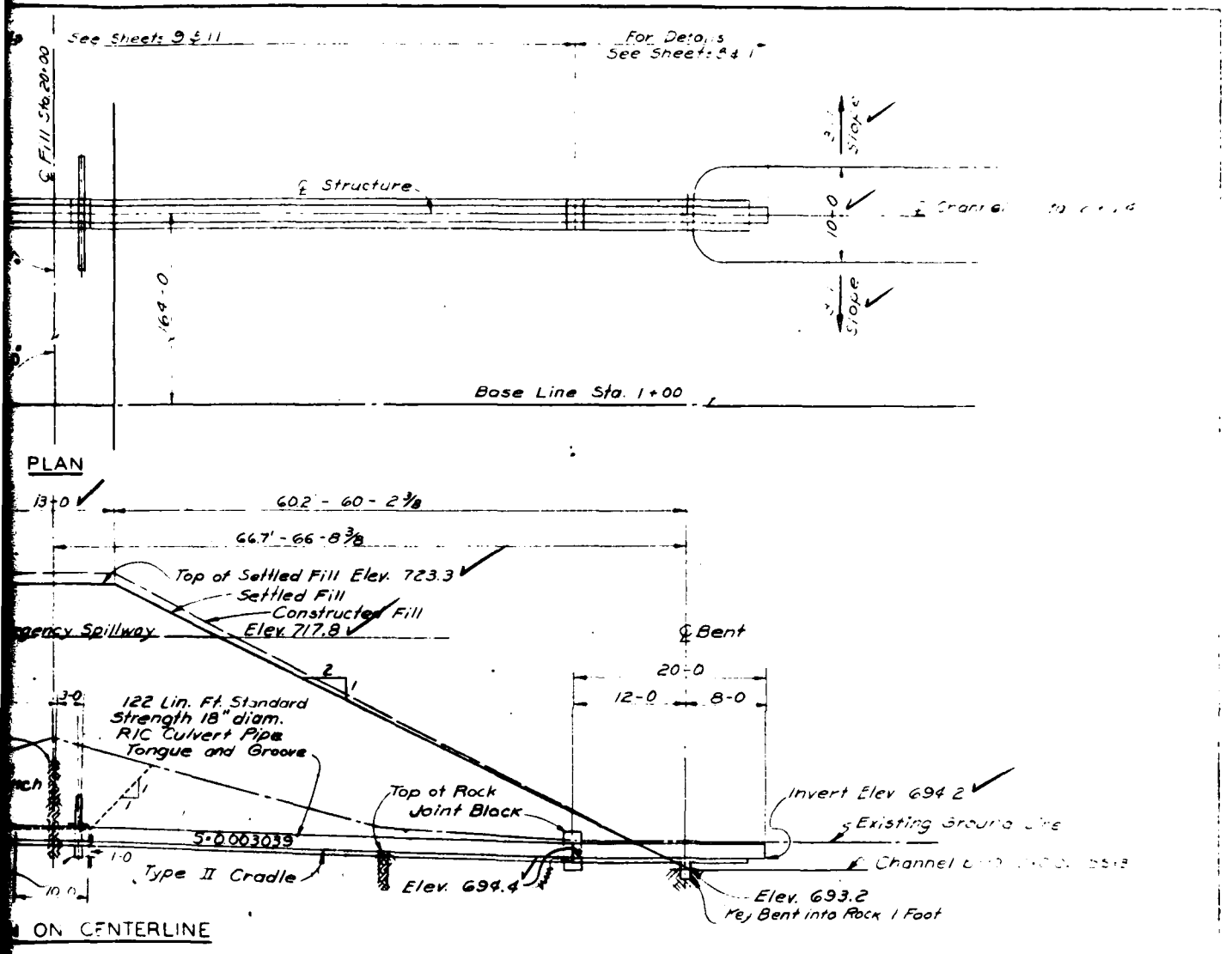
PLAN



SECTION ON CENTERLINE

Reinforced Concrete
Reinforcing Steel
Spillway, Reinforced Concrete
Standard Strength tongue
Guard Rail

PLATE-9



QUANTITIES

Reinforced Concrete _____ ~~6.01~~ Cu Yd 21.96 CUYDS
Reinforcing Steel _____ ~~1035.7~~ Pound 1043.7 LBS.
Spillway, Reinforced Concrete Culvert Pipe 18" diam Standard Strength tongue and groove _____ 122.0 Lin Ft
Guard Rail _____ Part Job

As Built - AH

STRUCTURE E-1 ℄ FILL STA. 20+00

R/C DROP INLET FOR 18 DIAM. PIPE
GENERAL LAYOUT
Lost Creek Watershed Protection Project
Soil District of Lincoln County, New Mexico
MINOR WATERSHED E PART 3
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Des. B.G. Browning, Geo. Daniels, H.N. Lueecke 4-28-57
Tr. R. Kuster 5-27-58
Checked J.A. Stasch 4-17-58

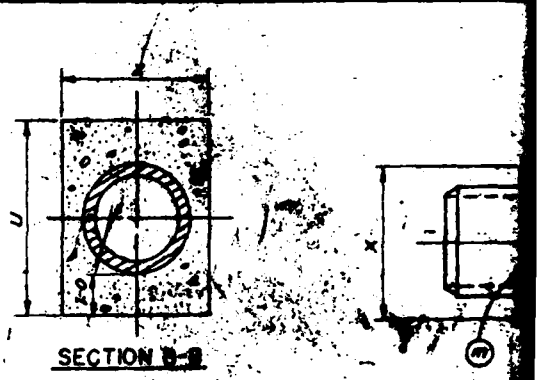
7 3-E-45620-P

SCALE : 1/8" = 1'-0"

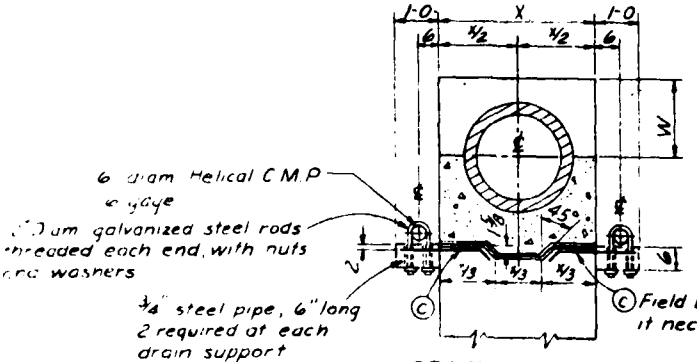
Pipe Diameter	12"				15"				18"				21"				24"				27"			
Length	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'
Pipe Dia.	0'-24"-0			0'-0"-24"-0	20"-0			20"-0	20"-0			20"-0	20"-0			20"-0	20"-0			20"-0	20"-0			20"-0
A	0'-6"-0			2'-0"-16"-0	12"-0			12"-0	12"-0			12"-0	12"-0			12"-0	12"-0			12"-0	12"-0			12"-0
B	1'-9"	3'-9"		1'-9"	3'-9"			3'-9"				3'-9"	1'-9"	3'-9"		1'-9"	3'-9"			1'-9"	3'-9"			1'-9"
C	0'-9"			0'-10"																				
D	3'-6"			3'-9"				4'-0"				4'-3"				4'-6"				4'-9"				
E				1'-1½"				1'-5½"				1'-7½"				1'-9"				1'-10¼"				
F	3'-3"			2'-6½"				3'-1"				3'-4½"				3'-8"				3'-11½"				
Footing & Bent	a	3	#4	6	2'-6	0'-9	1'-9					5'-0	2'-6											
Footing	b	1	#4	3	1'-9							5'-3	2'-6											
Drain Support (each)	c	1	#4	2	2'-0							4'-0	2'-6											
Bent	d	1	#4	6	7'-0							12'-0	7'-6											
Bent	e	4	#3	14	3'-3	1'-5	0'-5	1'-5				15'-6	4'-6											
Yoke	f	4	#4	2	5'-0	1'-6½	1'-1	1'-6½				10'-0	5'-3											
Yoke	g	1	#3	2	1'-0							2'-0	1'-6											
Cradle	h	1	#5	2	8'-0							16'-0	8'-6											
		1	#6	2																				
Additional Schedule to be used for L = 2																								
Cradle	k	1	#4	3	18'-0							54'-0	18'-0											
Cradle	l	1	#5	2	18'-0							36'-0	18'-0											
Cradle	m	4	#4	18	3'-0	0'-6½	1'-11	0'-6½				54'-0	3'-6											
Additional Schedule to be used for L = 2																								
Cradle	k	1	#4	3	22'-0							66'-0	22'-0											
Cradle	l	1	#5	2	22'-0							44'-0	22'-0											
Cradle	m	4	#4	22	3'-0	0'-6½	1'-11	0'-6½				66'-0	3'-6											

Pipe Diameter	12"				15"				18"				21"				24"				27"			
Length	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'	4'	6'	8'	10' 12'
Steel Quantities																								
#11	38.00		32.00	11.700	43.00			139.50	170.50			148.50	181.50			162.00	198.00			171.00	209.00			
#6 b	77.1		88.2	78.2	95.5			93.2	113.9			99.2	121.2			108.2	132.3			114.2	139.6			
#5 f	52.00		60.00	52.00	60.00			52.00	60.00			52.00	60.00			36.00	44.00			36.00	44.00			
#5 b	54.2		62.6	54.2	62.6			54.2	62.6			54.2	62.6			37.6	45.9			37.6	45.9			
#4 f																14.00				14.00				
#4 b																24.0				24.0				
Total Lb	126.8	150.8	132.8	158.1	174.4	176.5	153.4	183.8	169.8	202.2	175.6	209.5												
Drain Support #3 f									2.00															
Drain Support #3 b									0.8															
Drain Support #4 f	10.00			11.30				15.50				17.00				18.50				19.50				
Drain Support #4 b	6.7			7.7				10.4				11.4				12.4				13.0				
Total Lb	7.5			8.5				11.2				12.2				13.2				13.8				
Drain Support #5 f									4.00															
Drain Support #5 b									2.7															
Footing	0.09			0.13				0.23				0.25				0.27				0.29				
Bent	0.47			0.59				0.94				0.94				1.02				1.10				
Cradle	1.01	1.24		1.22	1.49			1.98	2.43	2.27	2.79	2.57	3.16	2.88	3.54									
Yoke	0.09			0.11				0.17				0.20				0.22				0.25				
Drain Support (each)									0.02															
Joint Block	0.48			0.55				0.70				0.78				0.86				0.94				

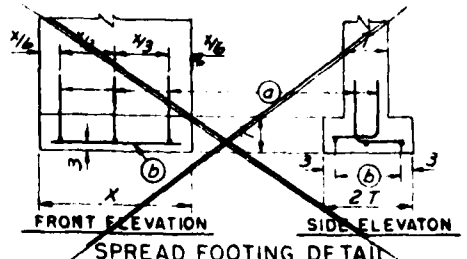
Notes
1. S dimension shown for 4' and 6' unit pipe lengths
2. See "SIDE ELEVATION" for yoke location for 8' unit pipe length
3. No yoke used with 10' and 12' unit pipe lengths



SECTION B-B

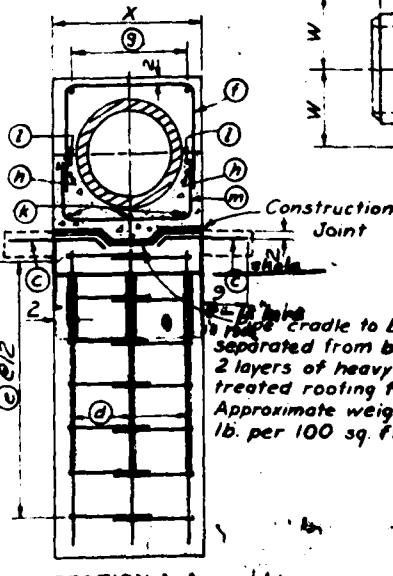


DRAIN SUPPORT DETAIL



SPREAD FOOTING DETAIL

To be used only when shown on General Layout



SECTION A-A

Pipe cradle to be separated from bent by 2 layers of heavy creosote treated roofing felt. Approximate weight lb. per 100 sq. ft.

Scale ½"=1'-0"

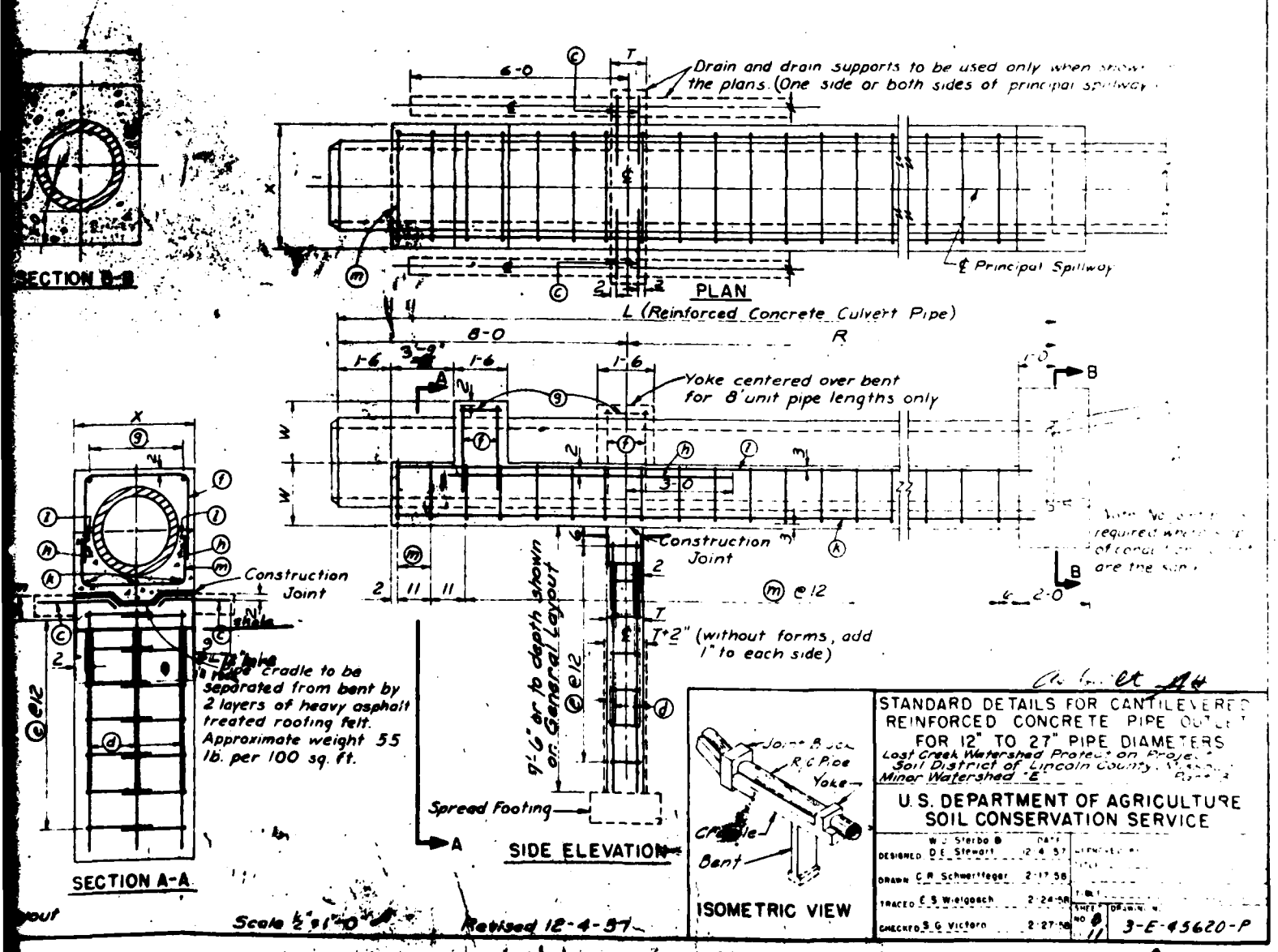
PLATE

STEEL SCHEDULE

Pipe Diameter — 18"

Mark	Type	Size	Quan	Length	A	B	C	Total	Length	A	B	C	Total
Schedule to be used for both L = 20-0 and L = 24-0													
a	3	#4	6	2-8	0-9	1-9		15-0	2-9	0-10	1-11		16-6
b	1	#4	3	1-9				5-3	2-0				6-0
c	1	#4	2	2-0				4-0	2-0				4-0
d	1	#4	6	7-0				42-0	7-0				42-0
e	4	#3	14	3-3	1-5	0-5	1-5	45-6	4-0	1-9	0-6	1-9	56-0
f	4	#4	2	5-0	1-6½	1-1	1-6½	10-0	5-9	1-9½	2-2	1-9½	11-6
g	1	#3	2	1-0				2-0	1-0				2-0
h	1	#5	2	8-0				16-0	8-0				16-0
	1	#6	2										
Additional Schedule to be used for L = 20-0 only													
k	1	#4	3	18-0				54-0	18-0				54-0
l	1	#5	2	18-0				36-0	18-0				36-0
m	4	#4	18	3-0	0-6½	1-11	0-6½	54-0	3-6	0-8	2-2	0-8	63-0
Additional Schedule to be used for L = 24-0 only													
k	1	#4	3	22-0				66-0	22-0				66-0
l	1	#5	2	22-0				44-0	22-0				44-0
m	4	#4	22	3-0	0-6½	1-11	0-6½	66-0	3-6	0-8	2-2	0-8	77-0

Mark	Type	Size	Quan	Length	A	B	C	Total
a	3	#4	6	3-0	1-0	2-0		18-0
b	1	#4	3	3-0				9-0
c	1	#4	2	2-0				4-0
d	1	#4	6	7-0				42-0
e	4	#3	14	4-9	2-0½	0-8	2-0½	66-6
f	4	#4	2	8-6	2-9	3-0	2-9	17-0
g	1	#3	2	2-0	1-0			2-0
h	1	#5	2	16-0				16-0
	1	#6	2	8-0				
k	1	#4	3	54-0	18-0			54-0
l	1	#5	2	36-0	18-0			36-0
m	4	#4	18	5-3	1-1½	3-0	1-1½	34-6
k	1	#4	3	66-0	22-0			66-0
l	1	#5	2	44-0	22-0			44-0
m	4	#4	22	5-3	1-1½	3-0	1-1½	115-6



Scale ½"=1'-0" Revised 12-4-57

STANDARD DETAILS FOR CANTILEVERED REINFORCED CONCRETE PIPE OUTLET FOR 12" TO 27" PIPE DIAMETERS

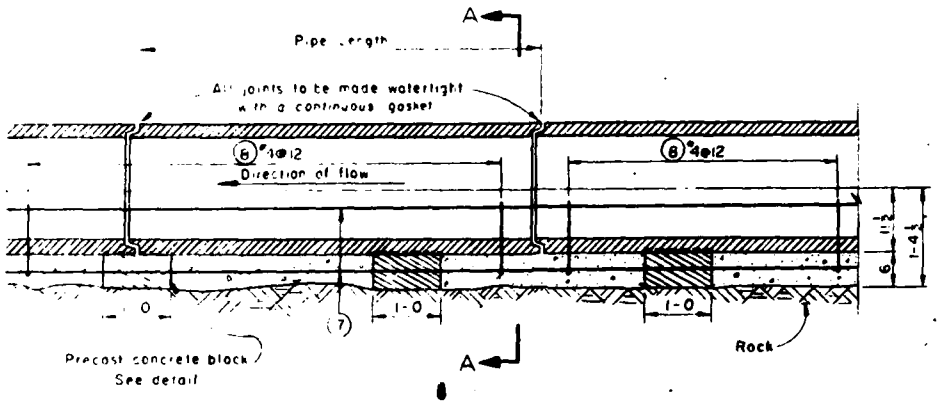
Lost Creek Watershed Protection Project
Soil District of Lincoln County
Miner Watershed "E"

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

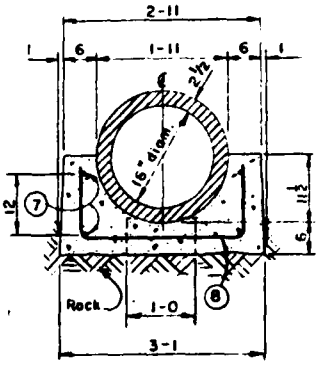
		DATE
DESIGNED	W.J. Sterbo & D.E. Stewart	12-4-57
DRAWN	C.R. Schwarteger	2-17-58
TRACED	E.S. Weigosch	2-24-58
CHECKED	S.G. Victoria	2-27-58

SHEET NO. 8 of 11 SHEETS — DRAWING NO. 3-E-45620-P

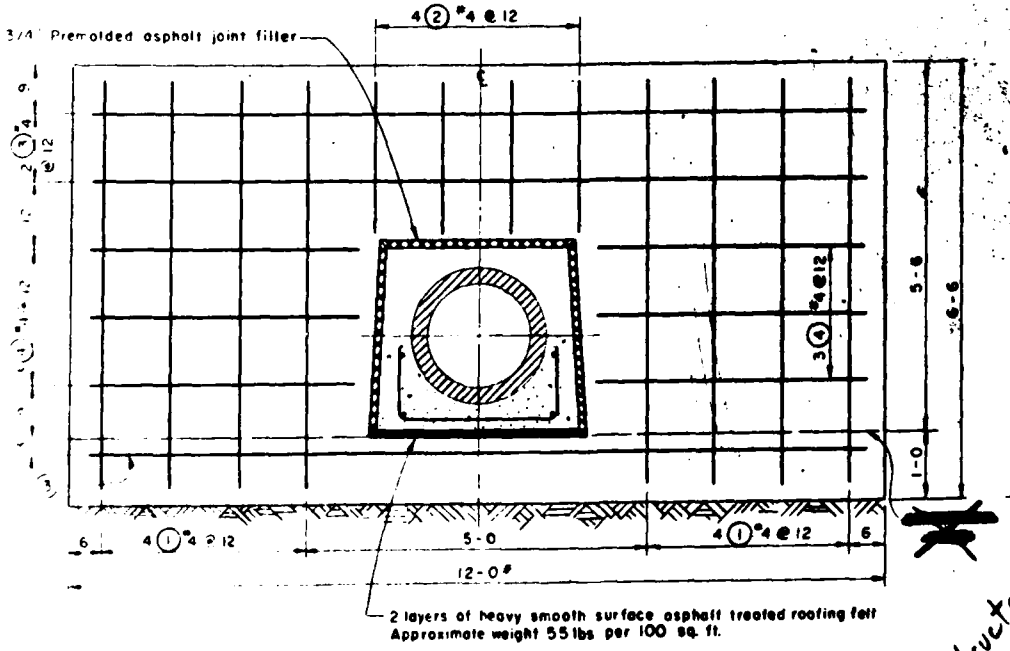
STANDARD DESIGN NO. 38475



DETAIL OF CRADLE AND BLOCK LOCATIONS



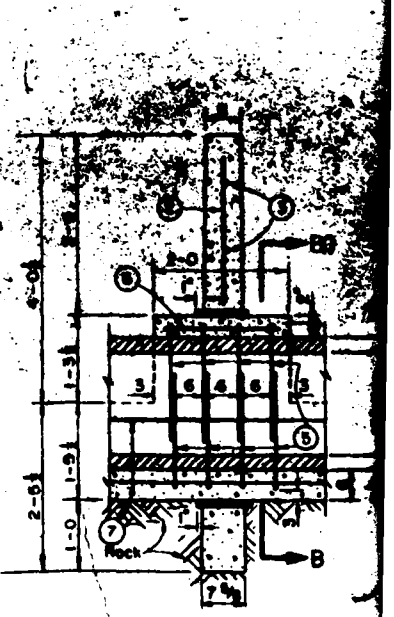
SECTION A-A



ELEVATION OF ANTI-SEEP COLLAR

Shown with Type II Cradle

* Note : length of collar maybe reduced to that required for a minimum extension of 1-0" into firm stone at the sides of structure



SECTION ON ℄

Shown with Type II Cradle

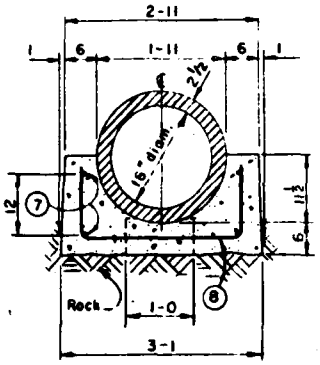
As Constructed

PLATE-11

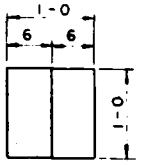
STEEL SCHEDULE

ANTI-SEEP COLLAR (FOR TYPE II CRADLE)

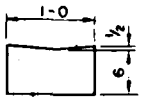
Location	Mark	Size	Quantity	Length	Type	A	B	C	D	E
Collar	1	#4	6	6 0	1					
	2		4	2 3						
	3		3	11-6						
	4		6	4 0						
	5		6	6 0	4	9	2-6	9	4	
	6		2	1-9						
TYPE II CRADLE (PER FT OF CRADLE)	7		5							
	8		1	4 9	4					



SECTION A-A



PLAN



FRONT ELEVATION

QUANTITIES

Reinforced Concrete _____

Steel #4 bars _____ 67.00 Lin Ft _____ 11.6

(For One (1) Anti-Seep Collar or)

By Contract Modification #1

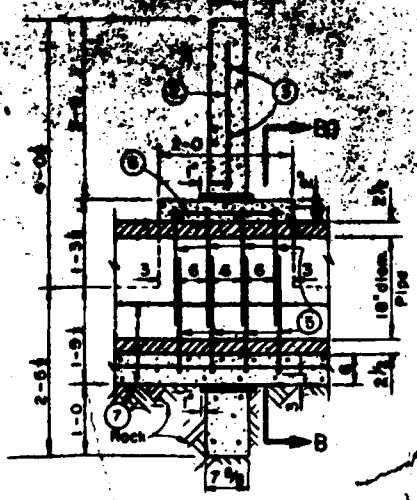
3 – Expansion Joints

R/C .95 Cu.Yds

Steel 10. Pounds

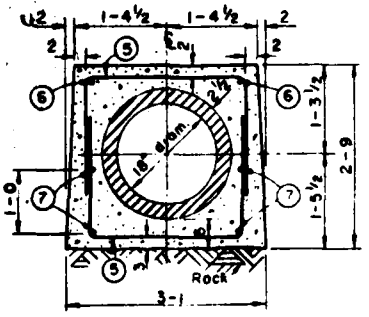
DETAILS OF PRECAST CONCRETE BLOCK

NOTE: Concrete building block or brick may be provided in lieu of precast concrete block as shown. (Scale 1" = 1'-0")



SECTION ON ℄

Shown with Type II Cradle



SECTION B-B

With Type II Cradle

STRUCTURE E-1 ℄ FILL STA.

DETAILS OF ANTI-SEEP COLLAR FOR 15" PIPE

Lost Creek Watershed Protection Project

Soil District of Lincoln County, Missouri

Minor Watershed E Part 3

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

H. Luebke 3-26-58

R. Kuster 4-1-58

D.J. Neubauer 4-8-58 No. 3-E-45620-K

Scale ¾" = 1'-0" unless shown

SCS 378 (November 1956)

9

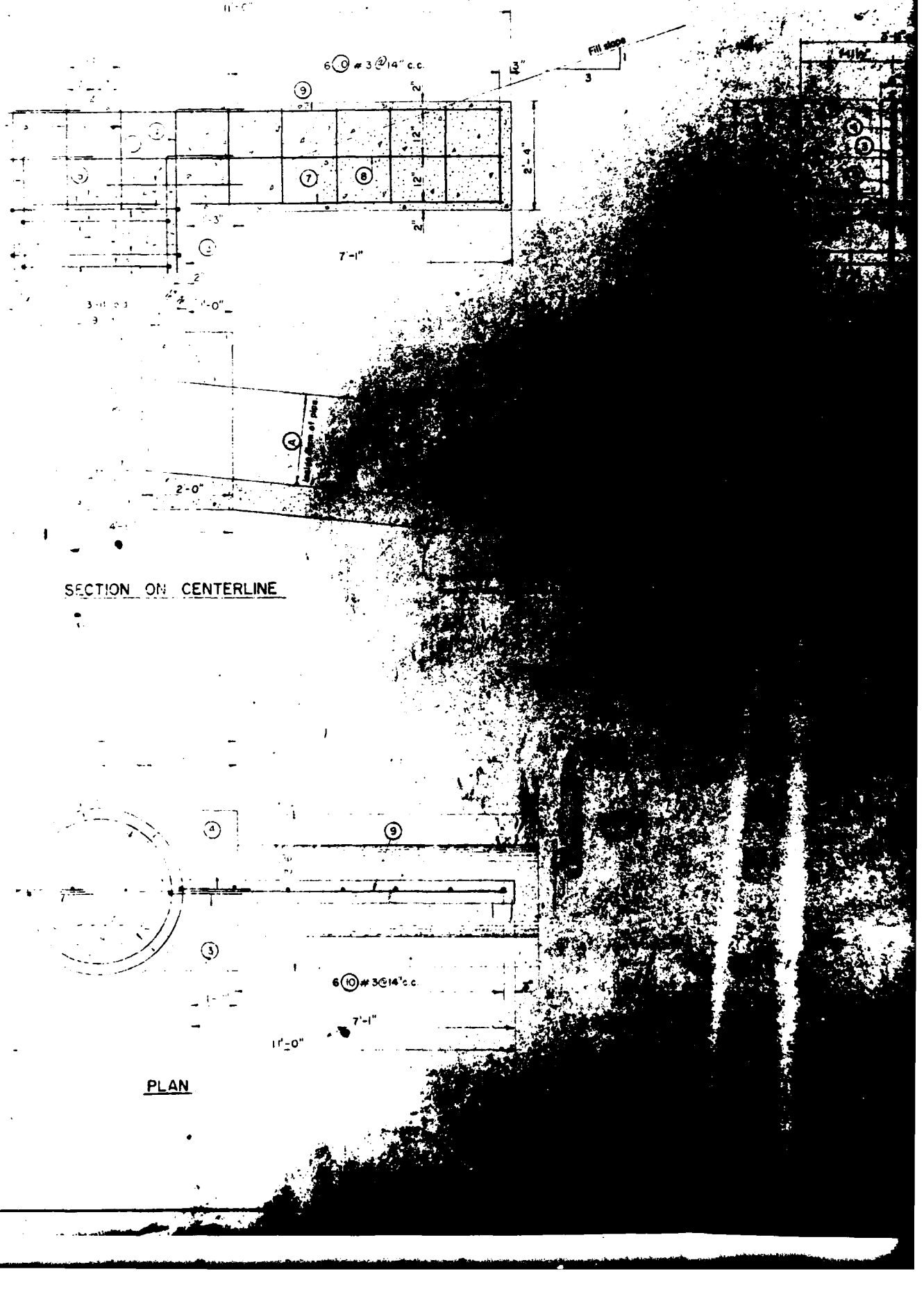
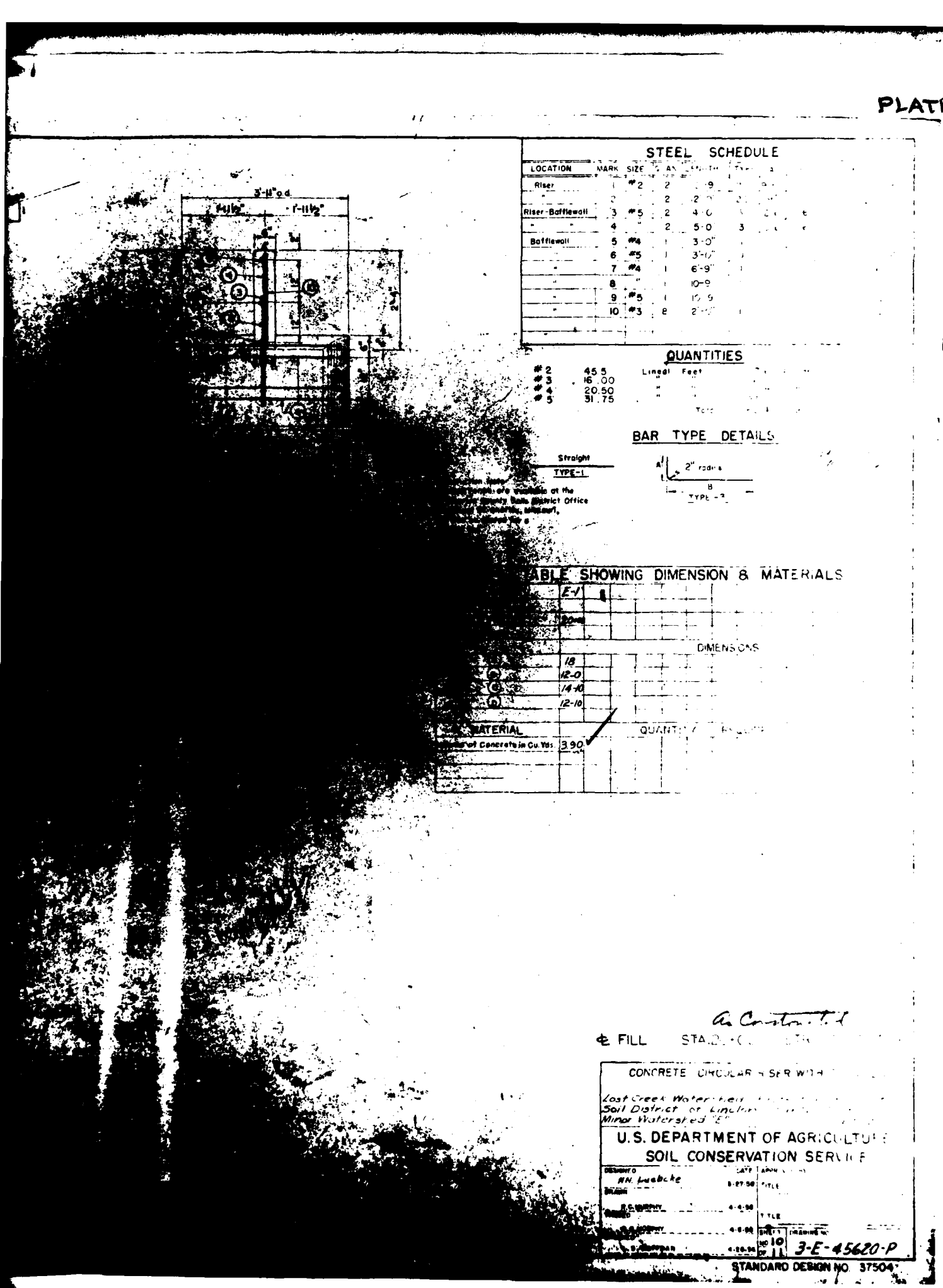

6 ⑥ # 3 @ 14" c.c.
Fill slope
1
3
12"
12"
2'-4"
7'-1"
2'-0"
2-0"
SECTION ON CENTERLINE
6 ⑩ # 3@14"c.c.
7'-1"
1'-0"
PLAN

PLATE-12



STEEL SCHEDULE

LOCATION	MARK	SIZE	NO.	LENGTH	TYPE
Riser	1	#2	2	1'-9"	
"	2		2	2'-2"	
Riser-Bafflewall	3	#5	2	4'-0"	L
" "	4	"	2	5'-0"	3
Bafflewall	5	#4	1	3'-0"	
"	6	#5	1	3'-0"	
"	7	#4	1	6'-9"	
"	8	"	1	10'-9"	
"	9	#5	1	10'-9"	
"	10	#3	8	2'-0"	

QUANTITIES

#2	45.5	Lineal Feet
#3	16.00	"
#4	20.50	"
#5	31.75	"

Total

BAR TYPE DETAILS

Straight

TYPE-1

2" radius

TYPE-2

...ABLE SHOWING DIMENSION & MATERIALS

	E-1	
	20"	
	DIMENSIONS	
1	18	
2	12-0	
3	14-10	
4	12-10	
MATERIAL	QUANTITY	REQUIRED
...of Concrete in Cu. Yds.	3.90	

...ons are available at the ...Soil District Office ..., Missouri, ...

As Constructed

℄ FILL STA. ... ℄ CUT

CONCRETE CIRCULAR RISER WITH ...

Lost Creek Watershed ...
Soil District of Lincoln ...
Minor Watershed "E"

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED	DATE	APPROVED
W.N. Luebke	8-27-58	TITLE
DRAWN		
P.C. Murphy	4-4-58	TITLE
CHECKED		
...	4-8-58	SHEET 1 OF 11
...	4-28-58	DRAWING NO. 10 3-E-45620-P

STANDARD DESIGN NO. 37504

2

WATERSHED DATA

Drainage Area = A
Controlled ______ Acres = ______ Sq Mi
Uncontrolled ______ Acres = ______ Sq Mi
Total A ______ Acres = ______ Sq Mi
Hazard ______
Hydrologic Soil Group ______
Watershed Design Runoff Curve ______ for Moist Cond II
Design Runoff Curve ______ for Moist Cond III

Time of Concentration
Length of Watershed ______ Feet
Difference in Elevation ______ Feet
Time to Peak (Hydrograph ES-1022) ______ Hours
Velocity ______ ft per sec
Dimensionless Unit Hydrograph Dimensions
Tp ______ Hours
Peak rate of runoff for unit hydrograph q_p ______ cfs

Emergency Spillway Drainage Required ______ Ac Ft

AVAILABLE SEDIMENT & SPILLWAY STORAGE

ELEV.	Stage in Feet	Area Flooded Acres	Interval Storage Acre Feet	Cumulative Storage Sediment Ac Ft	Cumulative Storage Water Ac Ft
[illegible]		E	[illegible]	[illegible]	
		2.[illegible]	[illegible]	[illegible]	
		3.48	[illegible]	[illegible]	
		[illegible]	2.5[illegible]		[illegible].56
	8.[illegible]				
		[illegible]	14.93		17.31
[illegible]	[illegible].5	[illegible]	[illegible]		31.87
[illegible]	[illegible]	[illegible]	[illegible].20		[illegible]1.[illegible]
772.0	[illegible]	[illegible]	15.[illegible]5		79.72

PRINCIPAL SPILLWAY DISCHARGE

WEIR Low Stage at Elev. 707.5
Size 3' [illegible]
$Q = CLH^{3/2}$
C = 3.4 L = 6.56 ft
Q = 22.3 $H^{3/2}$

h Feet	$h^{3/2}$	Q cfs
0	0	0
1.5	0.35[illegible]	7.9
[illegible]	0.5[illegible]	13.0
[illegible]	1.0	22.3
[illegible]	2.83	63.0
[illegible]	5.2	116.0
[illegible]	6.0	
[illegible]	11.2	
[illegible]		

ORIFICE Low Stage ℄ Elev ______
Size ______
$Q = Ca(2gh)^{1/2}$
C = ______ a = ______ sq ft
Q = ______ $h^{1/2}$

h Feet	$h^{1/2}$	Q cfs

CONDUIT

$Q = a\left(\frac{2g}{1.0+K_e+K_b+K_cL_c+K_sL_s}\right)^{1/2}H^{1/2}$

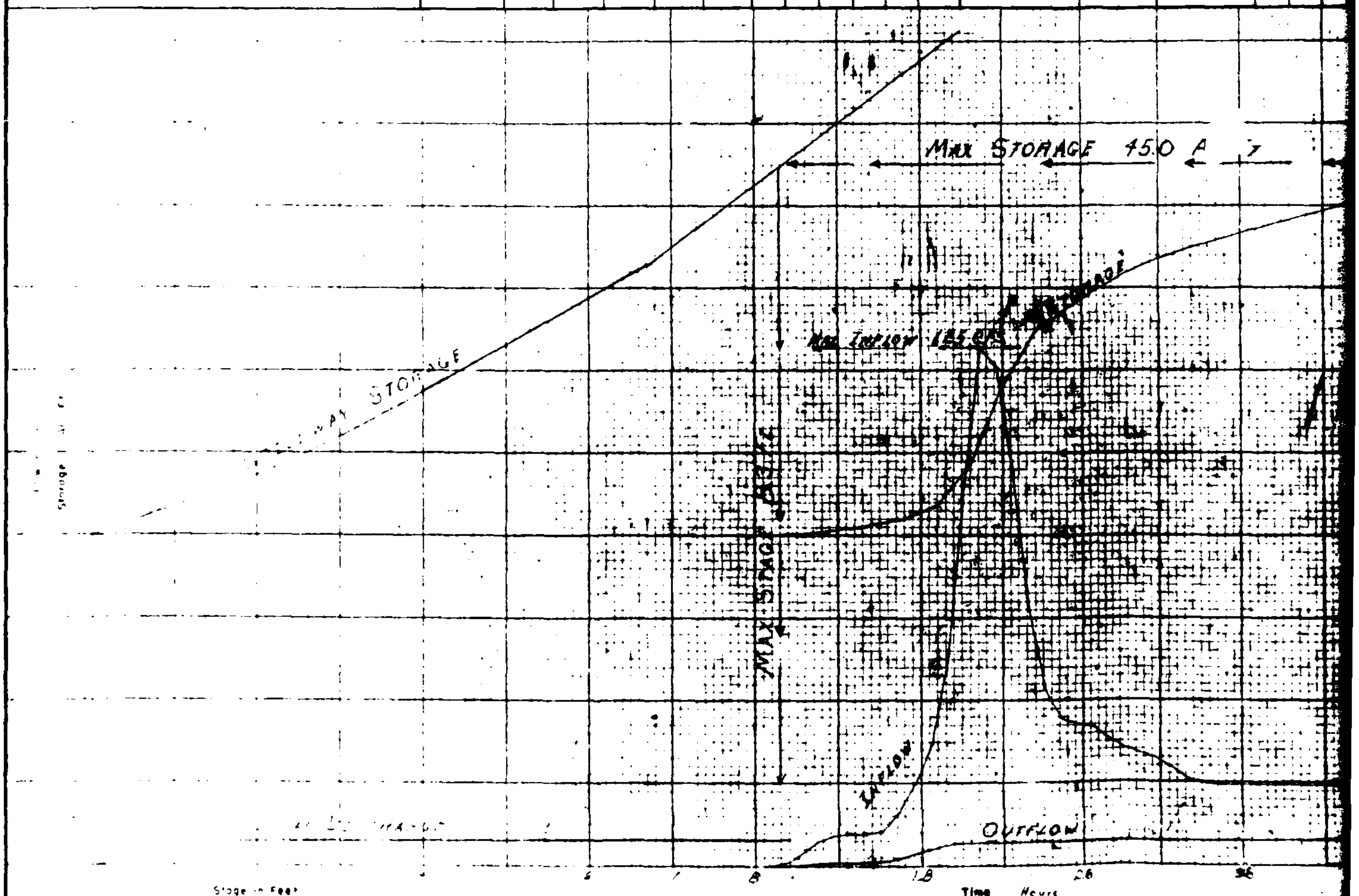
Type of Conduit	Length of Conduit ft	Size	n	K	K L
R/C	122	18"	0.018	0.0[illegible]	2.96

a = 1.77 sq ft K_e = [illegible] + K_b = 0.[illegible] + K_c ______ ΣK L

$Q = 1.77\left(\frac{64.4}{1.0+.7+2.96}\right)^{1/2}H^{1/2} = 6.58\ H^{1/2}$

H in Feet	$H^{1/2}$	Q in cfs
14.3	3.78	24.9
15.0	3.87	25.4
18.3	4.27	28.1
20.8	4.56	3[illegible]
[illegible]	4.[illegible]	[illegible]

WEIR at Elev. ______
Size ______
$Q = CLH^{3/2}$
C = ______ L = ______
Q = ______



HYDROGRAPH DATA

	PRINCIPAL SPILLWAY	EMERGENCY SPILLWAY	CHECK
Precipitation Frequency	[illegible] yrs		
6-Hr Point Rainfall (ES-1003, sheet 9) P	5.4		
6-Hr Point Rainfall (ES-1021) P		8.5 in	in
Ratio of Area to Point Rainfall (ES-1003)	[illegible] %	78 %	%
6-Hr Area Rainfall Modified P	5.29	12.85 in	in
For High Hazard 1.5 × Modified P		in	
[illegible] 1.25 × Modified P			in

Time Hours	Accum. Precip. Percent	Principal: Controlled Inflow c.f.s.	Principal: Accum. Precip. P - in.	Principal: Accum. Runoff Q - in.	Principal: Δ Q in.	Principal: Q_t c.f.s.	Emergency: Controlled Inflow c.f.s.	Emergency: Accum. Precip. P - in.	Emergency: Accum. Runoff Q - in.	Emergency: Δ Q in.	Emergency: Q_t c.f.s.
0.0	0.0										
0.5	3.5										
1.0	8.0										
1.5	13.5										
2.0	23.0										
2.5	60.0										
3.0	70.5										
3.5	78.0										
4.0	83.5										
4.5	88.0										
5.0	92.5										
5.5	96.5										
6.0	100.0										
6.5											
7.0											
7.5											
8.0											

Principal Spillway: Total 3.65 in
Total Vol. Runoff = R = (R/12) × Area) 186 = 56.6 Ac. Ft.

Emergency Spillway: Total ______ in
Total Vol. Runoff = R = (R/12) × Area) ______ = ______ Ac. Ft.

CHECK HIGH ... Total ...

PLATE-13

PRINCIPAL SPILLWAY DISCHARGE

CONDUIT

$Q = \left(\frac{2g}{10 + K_e + K_1 L_1 + K_2 L_2 + K_3 L_3}\right)^{1/2} h^{1/2}$

Length of Conduit ft	Size	n	K	K L
122	18"	0.014	0.0148	2.96

$Q = \left(\frac{2g}{10 + 2.96}\right)^{1/2} h^{1/2} = 6.58\ h^{1/2}$

Dis Feet	$h^{1/2}$	Q cfs
14.3	3.78	24.9
15.0	3.87	25.4
13.3	4.27	28.1
20.8	4.56	30
	4.7	

WEIR

at Elev. ____

Size ____

$Q = CLh^{3/2}$

$C = \_\_\_\_\ L = \_\_\_\_\ ft$

$Q = \_\_\_\_\ h^{3/2}$

h Feet	$h^{3/2}$	Q cfs

CONDUIT

$Q = \left(\frac{2g}{10 + K_e + K_1 L_1 + K_2 L_2 + K_3 L_3}\right)^{1/2} h^{1/2}$

Type of Conduit	Length of Conduit ft.	Size	n	K	K L

$Q = \_\_\_\_ h^{1/2}$ ft $K_e = \_\_\_\_ + K_b \_\_\_\_ = K_1 \_\_\_\_ = K L$

$Q = \left(\frac{64.4}{10 + \_\_\_\_}\right)^{1/2} h^{1/2} = \_\_\_\_ h^{1/2}$

H in Feet	$h^{1/2}$	Q in cfs

TOTAL DISCH.

Q cfs

EMERGENCY

Emergency Crest Elev. ____

PRELIMINARY DESIGN

$Q = (Q_c)(1.0 + .5 z\ Hec)$

Q_c from ES 98 Sheet 1 of 4

b: ____ ft z: ____

$Hec = Hec(1 + \alpha)$

α from ES 98 Sheet 4 of 4 for n: ____

L: ____ ft

FINAL DESIGN

Hp (feet)	Hec (feet)				Q cfs

MAINTENANCE STORAGE

Area under inflow hydrograph equals ____ (or indicate ac ft)

Area under outflow hydrograph equals ____ (or indicate cfs)

Principal Spillway ____ Emergency Spillway ____

Area under inflow hydrograph equals ____

Total volume of flood = ____ ac ft

Q = area under inflow hydrograph = ____ ac ft

S = ____ (or indicate in cfs)

R = ____ ac ft

Q = ____ ac ft

R = ____ ac ft

Required S = ____ ac ft

Error = ____ ac ft

Error = ____ %

Permissible error = 10%

Area between ____ routing and inflow curves equals Maximum ____ storage

Storage = $\frac{\_\_\_\_ \times 60 \times 60}{43560}$ = ____ ac ft

Q = area between curves = ____ sq in

S = ____ sq in/hr = ____ cfs

t = ____ hr

Q = ____ cfs

Storage (ac ft)

Storage (Max.) ____

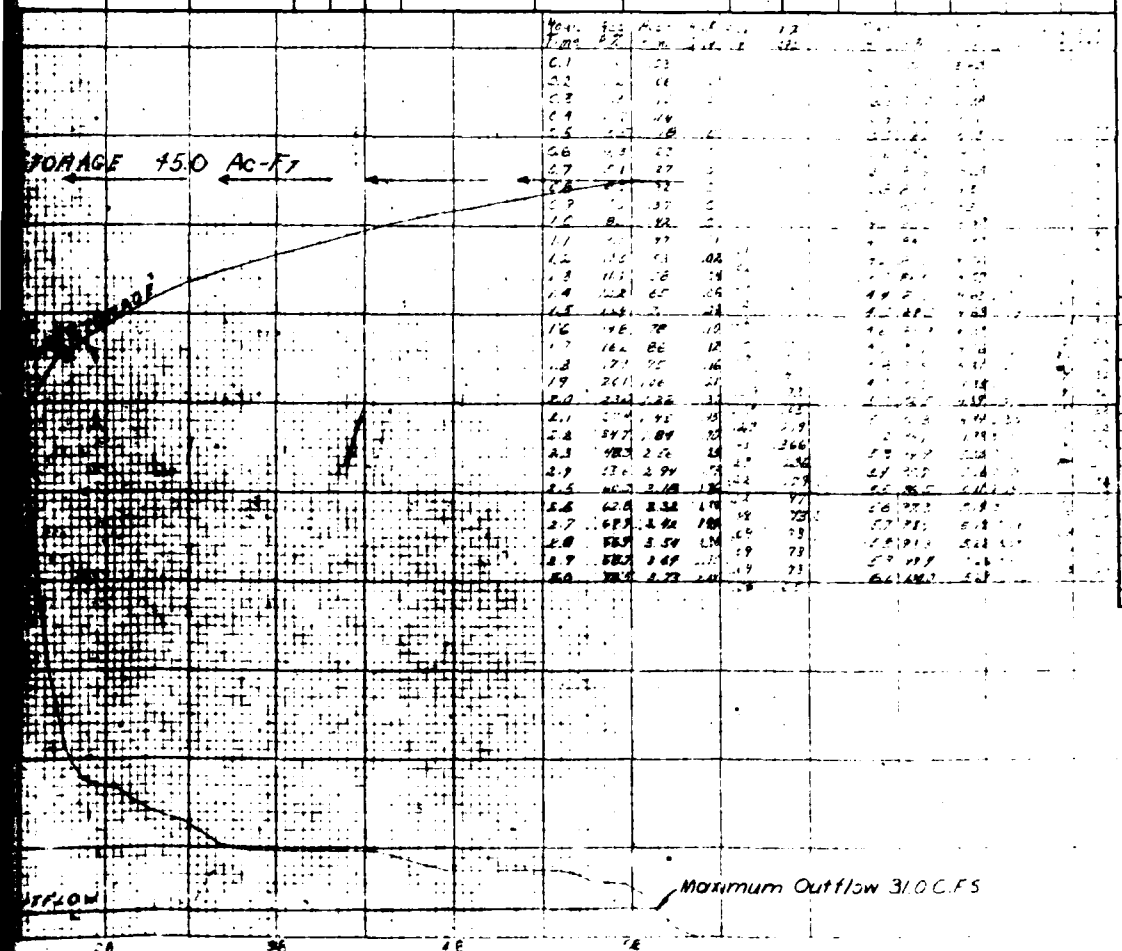
from Curve ____ ac ft

Error ____ ac ft

Error ____ %

Permissible error = 10%

TIME Hours	Principal Outflow cfs	Storage ac ft	Outflow + Storage cfs ac ft



RUNOFF HYDROGRAPH DEVELOPMENT FOR EMERGENCY SPILLWAY DESIGN

Time hrs	Accum. Precip. P - in	Accum. Runoff Q - in	Δ Q in	Qa cfs

Total ____ in

Total vol Runoff = Q: (____ x Area) ____ = ____ Ac Ft

CHECK HYDROGRAPH FOR HIGH HAZARD DESIGN

Time hrs	Inflow cfs	Accum. Precip. P - in	Accum. Runoff Q - in	Δ Q in	Qa cfs

Total ____ in

Total vol Runoff = Q: (____ x Area) ____ = ____ Ac Ft

SUMMARY DATA

Top of Embankment	Elev	____ ft
Emergency Spillway	Elev	____ ft
High Stage Inlet	Elev	____ ft
Low Stage Inlet	Elev	____ ft
Invert Inlet End of Conduit	Elev	____ ft
Invert Outlet End of Conduit	Elev	____ ft
Maximum Tailwater	Elev	____ ft
	Prin.	Emer. Check
Degree of Hazard	High	
Design Rate or Runoff (in)	3.4	
Peak Rate of Inflow (cfs)	62.4	
Maximum Discharge (cfs)	31	
Elev Maximum Stage (ft)	111.3	
Maximum Storage (ac ft)	45	
Available Sediment Storage Below Elev	____ ft	____ ac ft
Conduit Size	18"	
Riser Size		
Orifice		

FILL STRUCTURE

FLOOD ROUTING SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

45620-H
3-E-45 [illegible]-11

2

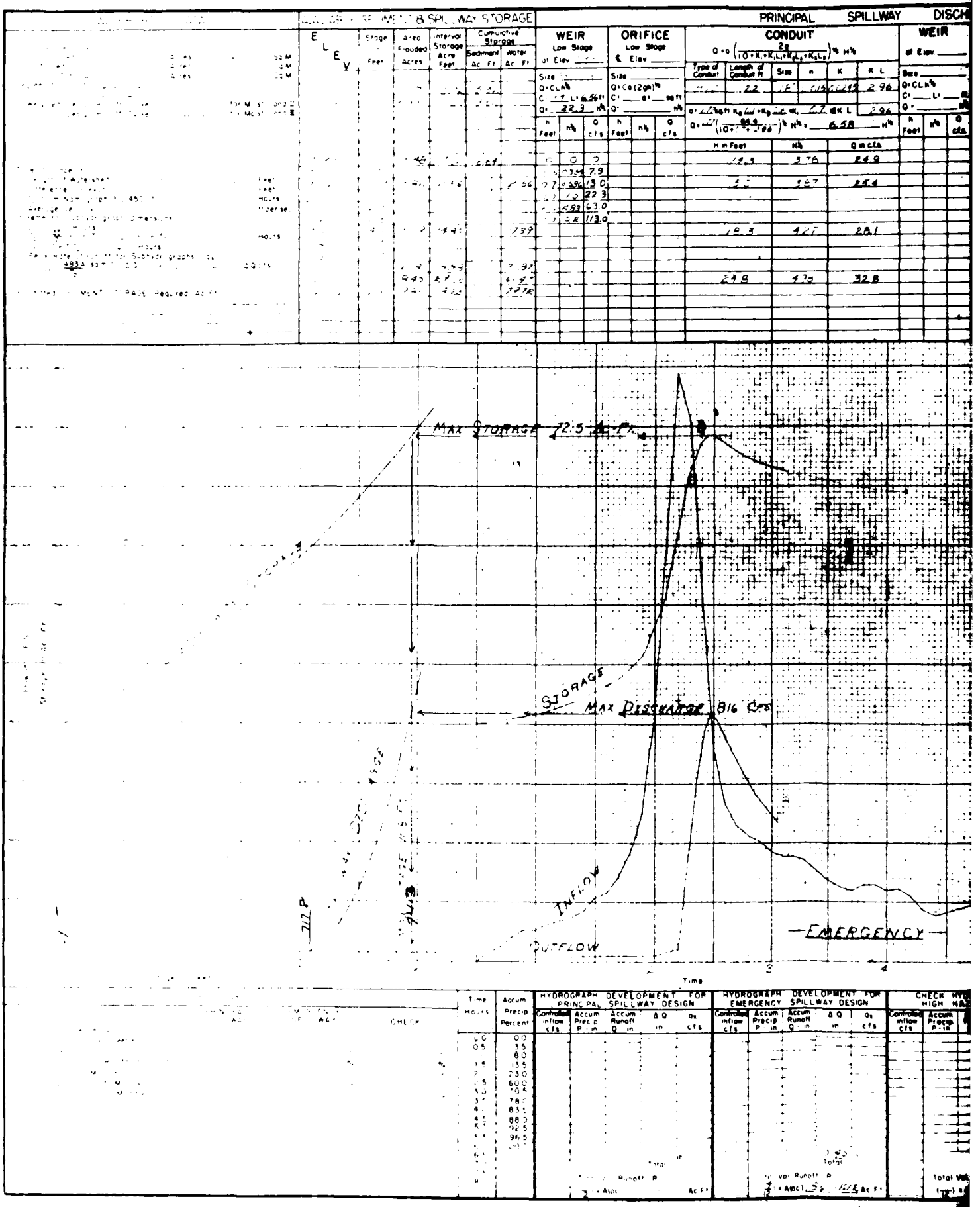

MAX STORAGE 72.5 Ac Ft
STORAGE
MAX DISCHARGE 816 cfs
INFLOW
OUTFLOW
EMERGENCY
Time

PLATE-14

PRINCIPAL SPILLWAY DISCHARGE

CONDUIT

$Q = \left(\frac{2g}{1.0 + K_e + K_1 L_1 + K_2 L_2 + K_3 L_3}\right)^{\frac{1}{2}} H^{\frac{1}{2}}$

Length of Conduit ft	Size	n	K	K L
22	18	0.15	2.15	2.96

ΣK_e and $+K_b$ and $+K_1 L_1$ etc. = 2.7 ΣK L = 2.96

$Q = \left(\frac{64.4}{1.0 + 2.96}\right)^{\frac{1}{2}} H^{\frac{1}{2}} = 6.58\ H^{\frac{1}{2}}$

H in Feet	$H^{\frac{1}{2}}$	Q in cfs
14.3	3.78	24.9
15.2	3.87	25.4
18.3	4.27	28.1
23.8	4.73	32.8

WEIR

at Elev ____

Size ____

$Q = C L H^{\frac{1}{2}}$

$C = \_\_\_\_\ L = \_\_\_\_\ H = \_\_\_\_\ Q = \_\_\_\_\ H^{\frac{1}{2}}$

h in Feet	$h^{\frac{1}{2}}$	Q cfs

CONDUIT

$Q = \left(\frac{2g}{1.0 + K_e + K_1 L_1 + K_2 L_2 + K_3 L_3}\right)^{\frac{1}{2}} H^{\frac{1}{2}}$

Type of Conduit	Length of Conduit ft	Size	n	K	K L

$Q = \_\_\_\_ \text{sq ft} \times K_e \_\_\_\_ + K_b \_\_\_\_ + K_1 \_\_\_\_ \Sigma K L \_\_\_\_$

$Q = \left(\frac{64.4}{1.0 + \_\_\_\_}\right)^{\frac{1}{2}} H^{\frac{1}{2}} = \_\_\_\_\ H^{\frac{1}{2}}$

H in Feet	$H^{\frac{1}{2}}$	Q in cfs

TOTAL DISCH

Q cfs

EMERGENCY

Emergency Crest Elev ____

PRELIMINARY DESIGN

$Q = (9c)(D)^{\frac{1}{2}} H^{\frac{1}{2}}$

9c from ES 98 Sheet 1 of 4

D = ____ ft

$Hp = Hec(L) + a_1$

a_1 from ES 98 Sheet 4 of 4 for n = ____

L = ____ ft

FINAL DESIGN

$Q = 204$

2 W.E.

W.B.F.F.

Hp (feet)	Hec (feet)	X	V	I	Q (cfs)
0.6	0.40	.38	3.2	0.25	51
1.0	0.86	.75	4.3	0.44	100
2.0	1.70	.90	6.1	1.11	227
3.0	2.7	.94	7.6	1.90	423
3.5	3.2	.96	8.3	2.40	514

TIME OF CONCENTRATION

Tc = Total ordinate, ac ft / Total ordinate, cfs x 726

	Principal	Emergency	Check
Tc	____ min	____ min	____ min

STORAGE VOLUME

Area under inflow hydrograph equals computed volume of Runoff

Total vol of Runoff = $\frac{s \times t \times 60 \text{ sec/min}}{43560 \text{ ft}^2/\text{ac ft}}$

a = area under inflow hydrograph = sq in

s = Scale of ordinate in cfs

t = Scale of horizontal = min

	Principal	Emergency	Check
s	ac ft		
t	cfs		
a	min		
R	sq in		
Storage (ac ft)	ac ft/in		
Storage (Max) from Curve (ac ft)	ac ft		
Error	ac ft		
Error	%		

Permissible Limit ±3%

OUTFLOW DISCHARGE

Area between corresponding inflow and outflow Curves equals Max mum Spillway Storage

Storage = $\frac{a \times t \times 60 \text{ sec/min}}{43560 \text{ ft}^2/\text{ac ft}}$

a = area between curves = sq in

s = Scale of ordinate in cfs

t = Scale of horizontal = min

	Principal	Emergency	Check
s	cfs		
t	min		
a	sq in		
Storage (ac ft)			
Storage (Max) from Curve (ac ft)			
Error	ac ft		
Error	%		

Permissible Limit ±3%

HYDROGRAPH EXTENSION

TIME	Principal		Emergency		Check	
	Outflow	Storage	Outflow	Storage	Outflow	Storage
Hours	cfs	ac ft	cfs	ac ft	cfs	ac ft

Time	Qs	Qc	I	ΔQ	S
0.1	3.6	0.27			
0.2	7.2	0.74			
0.3	11	0.23			
0.4	2.7	0.33			
0.5	3.5	0.43	0.90	0.24	8.2
0.6	4.3	3.8	5.11	0.08	14.2
0.7	5.1	0.62	0.03	0.18	16.8
0.8	6.0	0.73	0.06	0.26	49.7
0.9	7.0	0.86	0.11	0.37	54.9
1.0	8.0	3.99	0.18	0.47	56.3
1.1	9.6	1.16	0.28	0.35	65.3
1.2	10.0	1.28	0.36	0.09	65.3
1.3	11.0	1.35	0.38	0.07	56.7
1.4	11.8	1.40	0.46	0.10	3.4
1.5	13.5	1.65	0.55	0.15	96.5
1.6	14.8	1.81	0.78	0.16	77.5
1.7	16.2	1.99	0.80	0.15	16.2.0
1.8	17.9	2.19	0.93	0.27	11.2
1.9	20.1	2.46	1.16	0.23	227.0
2.0	23.0	2.82	1.44	0.32	164.0
2.1	27.4	3.30	1.91	0.72	1.1.1
2.2	34.1	4.12	2.70	0.8	1.1.1
2.3	48.2	5.71	4.23	1.1	1.1.1
2.4	15.1	1.78	5.12	0.9	1.1.1
2.5	6.10	7.35	1.23	1.1	1.1.1
2.6	2.28	9.27	1.15	1.1	1.1.1
2.7	2.49	1.04	6.14	1.1	1.1.1
2.8	2.7	3.16	1.15	1.1	1.1.1
2.9	2.91	3.41	6.13	1.1	1.1.1
3.0	2.15	0.14	1.12	1.1	1.1.1
3.1	1.2	1.2	1.19	1.1	1.1.1
3.2	3.1	1.2	1.18	1.1	1.1.1
3.3	3.1	1.39	1.1	1.1	1.1.1
3.4	3.2	1.5	1.18	1.1	1.1.1
3.5	3.4	1.19	1.19	1.1	1.1.1
3.6	3.4	1.3	1.19	1.1	1.1.1
3.7	3.5	1.3	1.19	1.1	1.1.1
3.8	3.5	1.39	1.19	1.1	1.1.1
3.9	3.6	1.4	1.19	1.1	1.1.1
4.0	3.6	1.4	1.19	1.1	1.1.1
4.1	3.7	1.4	1.19	1.1	1.1.1
4.2	3.7	1.4	1.19	1.1	1.1.1
4.3	3.8	1.4	1.19	1.1	1.1.1

B16 Cfs

EMERGENCY

SPILLWAY SEDIMENT POOL

Controlled Spillway Design

Controlled Inflow cfs	Accum Precip P in	Accum Runoff Q in	Δ Q in	Δ Q cfs

Ac Ft

CHECK HYDROGRAPH FOR HIGH HAZARD DESIGN

Controlled Inflow cfs	Accum Precip P in	Accum Runoff Q in	Δ Q in	Δ Q cfs

SUMMARY DATA

Top of Embankment	Elev
Emergency Spillway	Elev
High Stage Inlet	Elev
Low Stage Inlet	Elev
Invert Inlet End of Conduit	Elev
Invert Outlet End of Conduit	Elev
Max mum Tailwater	Elev
Degree of Hazard	
Design Rate of Runoff	
Peak Rate of Inflow	
Max mum Discharge	cfs
Elev Maximum Stage	
Maximum Storage	
Available Sediment Storage Below Elev	
Conduit Size	
Inlet Style	
Outlet	

FLOOD ROUTING SPILLWAY

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Sheet 3 of ____ Sheets

2

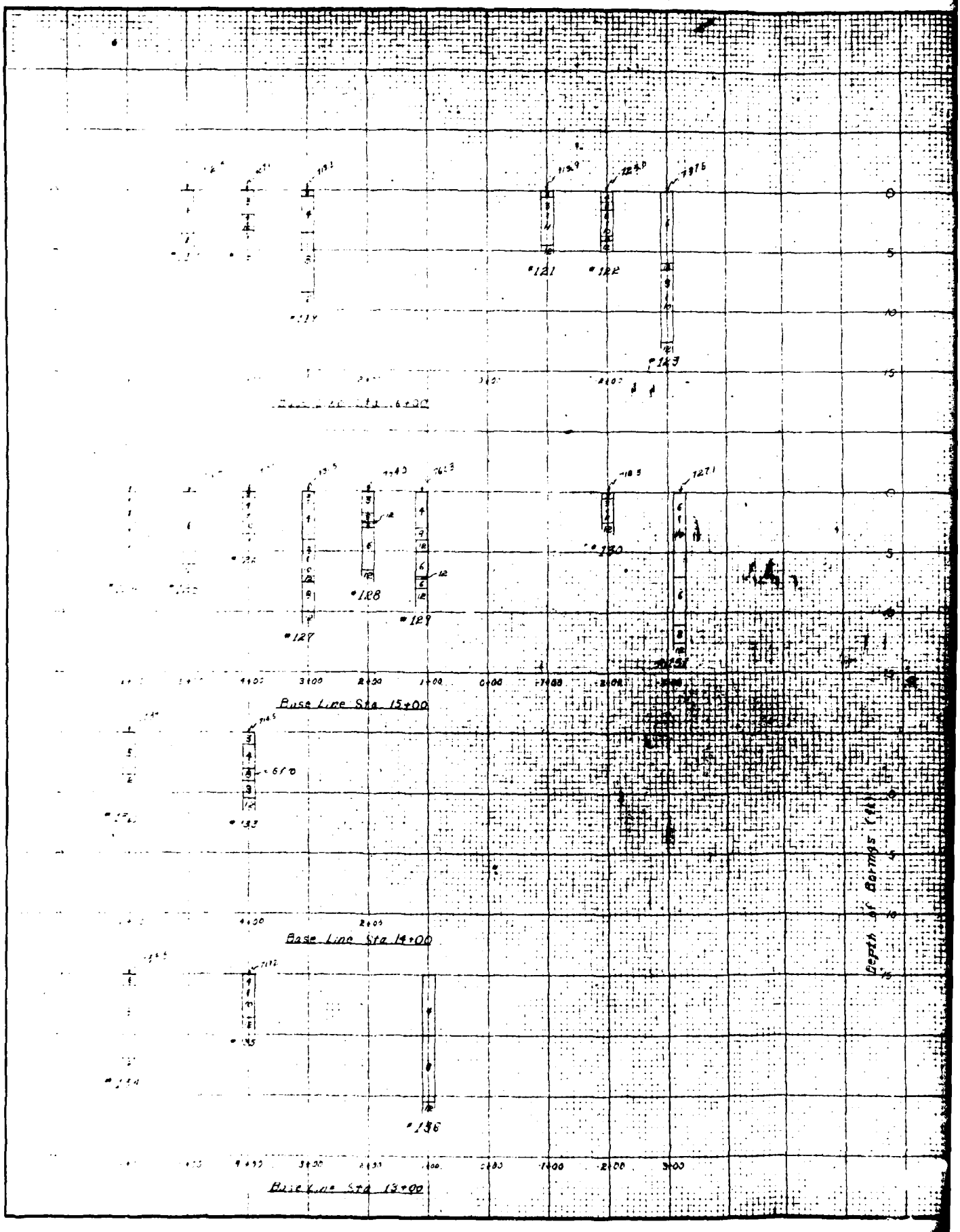
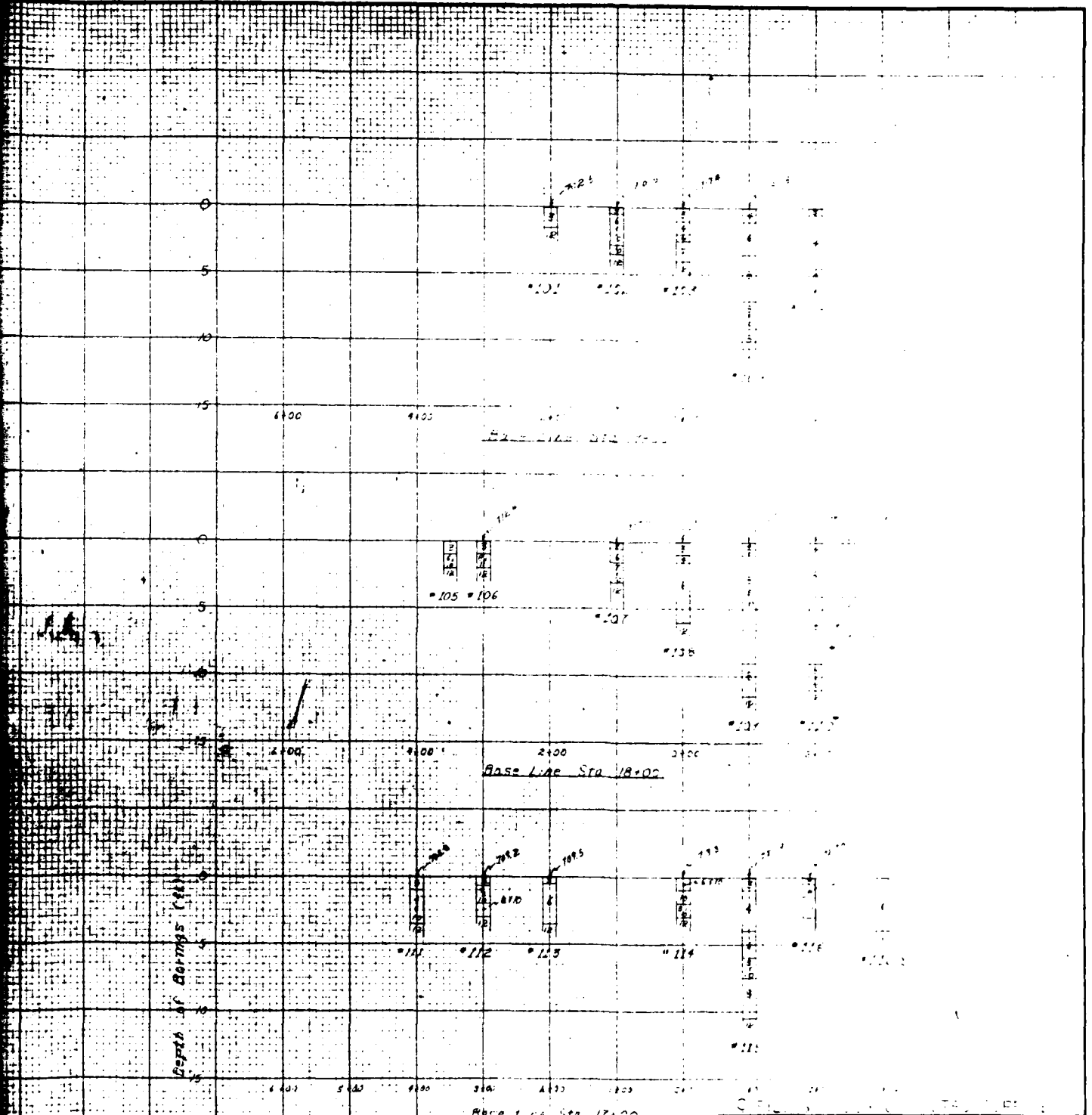

#121
#122
#123
Base Line Sta 16+00
#127
#128
#129
#130
#131
Base Line Sta 15+00
#133
Base Line Sta 14+00
#135
#136
Base Line Sta 13+00
Depth of Borings (ft)

PLATE-15



U.S. SURFACE MINING
BORROW AREA
LOG OF [illegible] WATERSHED
SOIL ESTIMATE OF [illegible]
MISSISSIPPI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
Drawn		Title
Traced		
Checked		Sheet No. 4 of 4 sheets

3-E-456(2)-C

PLATE 16

SCALE

10 0 10 20 30 40 Miles

⊕ LOCATION OF DAM

NOTE: LEGEND OF THIS DAM IS ON PLATE 17

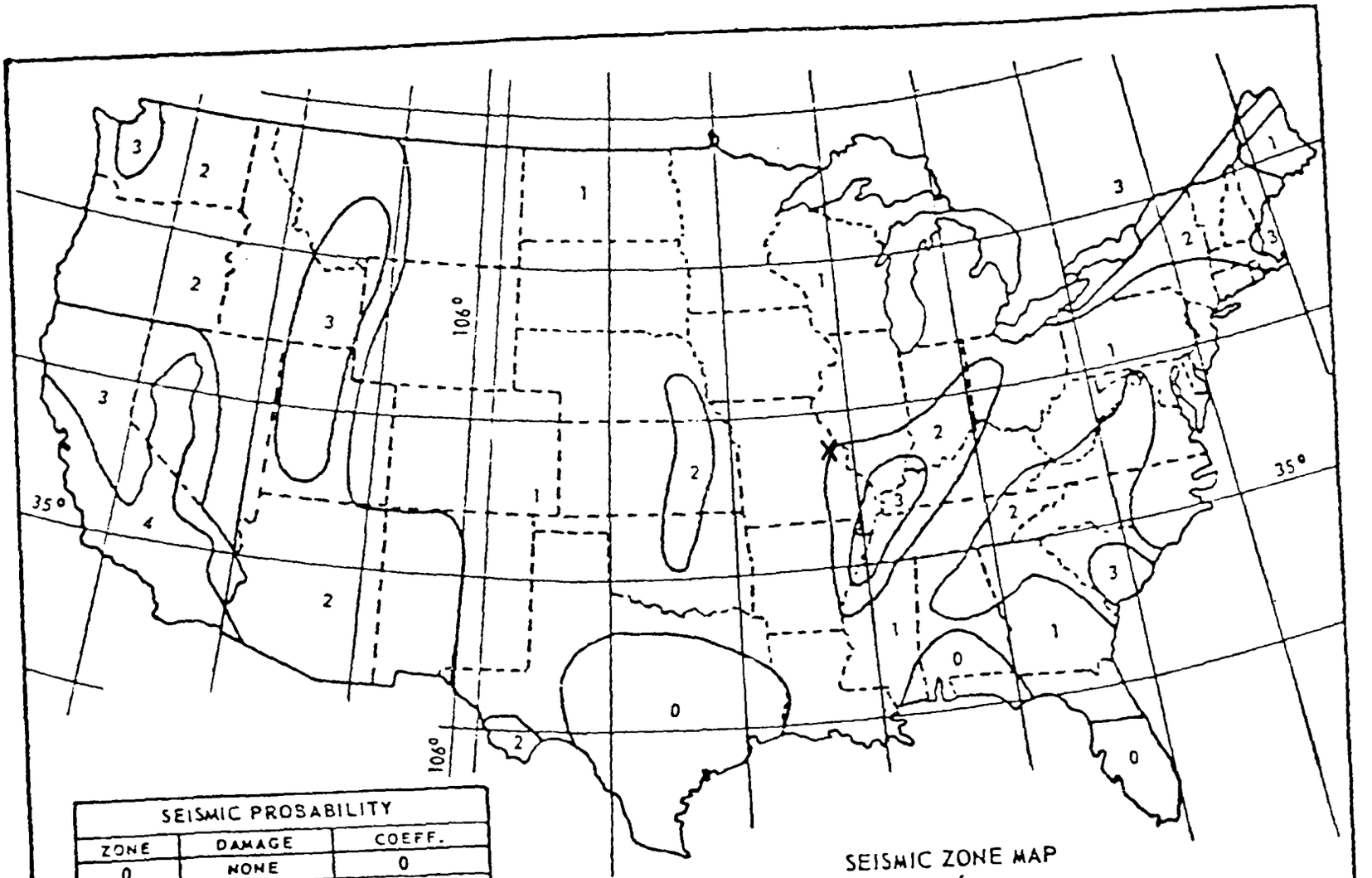
REFERENCE:

GEOLOGIC MAP OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
KENNETH H. ANDERSON, 1979

REGIONAL GEOLOGICAL MAP OF GENTRY LAKE DAM

LEGEND

PERIOD	SYMBOL	DESCRIPTION
QUATERNARY	Qal	ALLUVIUM: SAND, SILT, GRAVEL
PENNSYLVANIAN	Pm	MARMATON GROUP: CYCLIC DEPOSITS OF SHALE, LIMESTONE AND SANDSTONE
	Pcc	CHEROKEE GROUP: CYCLIC DEPOSITS OF SHALE, LIMESTONE AND SANDSTONE
MISSISSIPPIAN	Mm	ST. LOUIS FORMATION: LIMESTONE INTERBEDDED WITH SHALE
	Mm	SALEM FORMATION: LIMESTONE INTERBEDDED WITH SHALE AND SILTSTONE
	Mm	WARSAW FORMATION: ARGILLACEOUS LIMESTONE AND CALCAREOUS SHALE
	Mo	KEOKUK- BURLINGTON FORMATION: CHERTY GRAYISH BROWN SANDY LIMESTONE
	Mk	NORTHVIEW- COMPTON AND BACHELOR FORMATION
DEVONIAN	D	CHATTANOOGA SHALE SYLAMORE SANDSTONE
ORDOVICIAN	Omk	MAQUOKETA SHALE: KIMMSWICK LIMESTONE
	Odp	DECORAH FORMATION: GREEN TO GRAY CALCAREOUS SHALE WITH THIN FOSSILIFEROUS LIMESTONE



SEISMIC PROSABILITY		
ZONE	DAMAGE	COEFF.
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

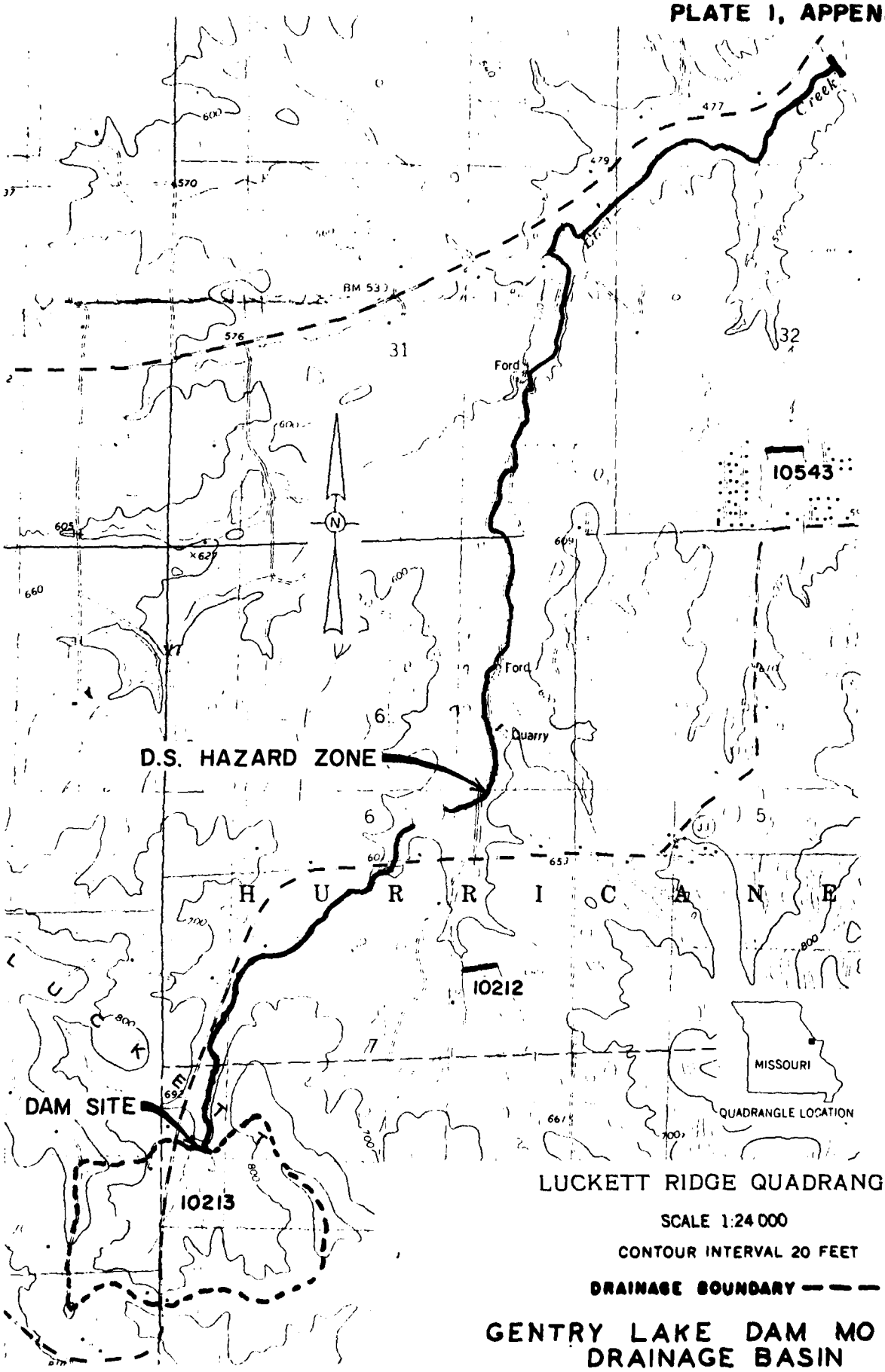
X APPROXIMATE LOCATION OF GENTRY LAKE DAM

PLATE 18

APPENDIX B

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

PLATE I, APPENDIX B



LUCKETT RIDGE QUADRANGLE

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET

DRAINAGE BOUNDARY — — — —

GENTRY LAKE DAM MO 10213
DRAINAGE BASIN

EC1-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION/MISSOURI-1980 SHEET NO. 1 OF 2

GENTRY LAKE DAM JOB NO. 1263

PRINCIPAL SPILLWAY DISCHARGE BY MAS DATE 5-9-80

GENTRY LAKE DAM

PRINCIPAL SPILLWAY DISCHARGE

Information From SCS DWGS:

PRINCIPAL SPILLWAY DISCHARGE

WEIR			ORIFICE			CONDUIT							WEIR			CONDUIT						TOTAL DISCH.
Low Stage @ Elev. 704.5			Low Stage @ Elev.			$Q=\left(\frac{2g}{1.0+K_e+K_1L_1+K_2L_2}\right)^{\frac{1}{2}} hA_2$							@ Elev.			$Q=\left(\frac{2g}{1.0+K_e+K_1L_1+K_2L_2}\right)^{\frac{1}{2}} hA_2$						
Size 54" circ			Size			Type of Conduit: RC	Length of Conduit ft: 122	Size: 18"	n: 0.014	K: 0.0245	K L: 2.98		Size			Type of Conduit	Length of Conduit ft	Size	n	K	K L	
$Q=CLh^{\frac{3}{2}}$			$Q=Ca(2gh)^{\frac{1}{2}}$			$Q=\frac{1.27 n^2 K_e L_1 + K_2 L_2 + K_3}{\left(1.0+K_e+\frac{29.0}{n^2}R^{\frac{4}{3}}\right)^{\frac{1}{2}}} hA_2 = \frac{1.27}{\left(1.0+0.5+\frac{29.0}{0.014^2}\cdot 0.75^{\frac{4}{3}}\right)^{\frac{1}{2}}} \cdot 3.14 = 6.58\ cfs$							$Q=\frac{1.27 n^2 K_e L_1 + K_2 L_2 + K_3}{\left(1.0+K_e+\frac{29.0}{n^2}R^{\frac{4}{3}}\right)^{\frac{1}{2}}} hA_2$							
C: 3.2 L: 6.28 ft			C: ___ a: ___ sq ft										C: ___ L: ___ ft									
$Q=22.3\ cfs$			$Q=$ ___ cfs										$Q=$ ___ cfs									
h Feet	hA	Q cfs	h Feet	hA	Q cfs	H in Feet	hA	Q in cfs					h Feet	hA	Q cfs	H in Feet	hA	Q in cfs				Q cfs
0	0	0																				
0.8	0.36	7.9				14.3	3.78	24.9														
0.7	0.49	13.0				15.0	3.87	25.4														
1.0	1.0	22.3																				
1.4	1.96	43.0																				
1.5	2.12	47.2																				
						18.3	4.27	28.1														
						29.8	4.98	32.8														

Size = 36" According to field measurement

$$Q_W = CLh^{3/2} = 3.4 \times \pi \times 3' \times h^{3/2} = 32h^{3/2}$$

Calculation of Discharge:

W.S. Elev.	WEIR FLOW		PRESSURE FLOW		Controlling Discharge Q_R	
	h	$Q_W=32h^{3/2}$	H	$Q_c=6.58H^{1/2}$		
709.5	0	0			0	
710	0.5	11.30			11.30	
710.2	0.7	18.70	15	25.5	18.70	
710.5	1.0	32.0	15.3	25.7	25.70	*
711.0			15.8	26.2	26.2	
715			19.8	29.3	29.3	
719.0			23.8	32.1	32.1	
720.0			24.8	32.8	32.8	
724.5			29.3	35.6	35.6	
720.5			25.3	33.1	33.1	
721.8			26.6	33.9	33.9	
723.2			28.0	34.8	34.8	
725.1			29.9	36.0	36.0	
725.8			30.6	36.4	36.4	
726.5			31.3	36.8	36.8	
727.0			31.8	37.1	37.1	
729.5			34.3	38.5	38.5	

* Check for orifice flow:

$$Q_o = 0.6 A \sqrt{2gh}$$

$$= 0.6 \times .785 \times 9 \sqrt{64.4 \times 1'}$$

$$= \underline{34 \text{ cfs}}$$

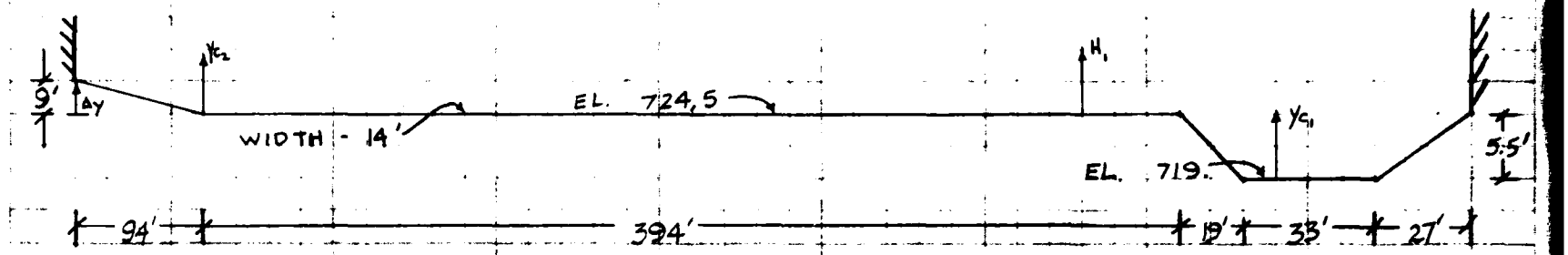
Orifice flow cannot occur.

EC1-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI - 1980 SHEET NO. 1 OF 1

GENTRY LAKE DAM (MO 10212) JOB NO. 1263

EMERGENCY SPILLWAY AND OVERTOP RATING CURVE BY JEK DATE 5/14/80



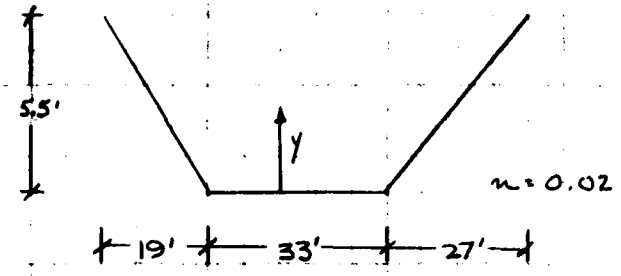
Y_{c_1}	A_{c_1}	T_{c_1}	$V_{c_1}=\sqrt{\frac{A_c}{T_c}g}$	$V_{c_1}^2/2g$	$Q_{c_1}=A_{c_1}V_{c_1}$	U/S W.S.= $Y_{c_1}+V_{c_1}^2/2g$ + 719.	C_1	L_1	H_1	$Q_1=C_1L_1H_1^{3/2}$	$Y_{c_2}=\frac{2}{3}(H_1+\frac{1}{4}\Delta Y)$	T_{c_2}	A_{c_2}	$Q_{c_2}=\left(\frac{A_{c_2}^3 g}{T_{c_2}}\right)^{1/2}$	$Q_T=Q_{c_1}+Q_1+Q_{c_2}$
0	0	0	0	0	0	719.	–	–	–	–	–	–	–	–	0
1	37.2	41.4	5.4	0.45	200.8	720.5	–	–	–	–	–	–	–	–	201
2	82.7	49.7	7.3	0.83	603.7	721.8	–	–	–	–	–	–	–	–	604
3	136.6	58.1	8.7	1.17	1188.4	723.2	–	–	–	–	–	–	–	–	1188
4	198.9	66.5	9.8	1.49	1949.2	724.5	–	–	–	–	–	–	–	–	1949
4.5	233.2	70.6	10.3	1.65	2402.0	725.1	2.70	394	0.6	494.4	0.5	5.22	1.31	3.7	2900
5	269.6	74.8	10.8	1.81	2911.7	725.8	2.64	394	1.3	1541.8	1.04	10.86	5.65	23.1	4477
5.5	308.0	79.0	11.2	1.95	3449.6	726.5	2.63	394	2.0	2930.9	1.6	16.70	13.36	67.8	6448
6	324.5	79.0	11.5	2.05	3731.8	727.0	2.63	394	2.5	4096.0	2.0	20.88	20.88	118.5	7946
8	390.5	79.0	12.6	2.47	4920.3	729.5	2.63	394	5.0	11585.3	4.0	41.76	83.52	670.2	17176
12	522.5	79.0	14.6	3.30	7628.5	734.3	2.63	394	9.8	31790.0	7.84	81.85	320.9	3605.6	43024

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI - 1980 SHEET NO. 1 OF 1

GENTRY LAKE DAM (MO 10213) JOB NO. 1263

CHECK EMERGENCY SPILLWAY SLOPE BY JFK DATE 5/14/80



$T = y\,(44/5.5) + 33$

$A = y\,(1/2\,y\,(44/5.5) + 33)$

$Q = \left(\frac{gA^3}{T}\right)^{1/2}$ and $S_c = \left[\frac{Q_c\, n}{1.49\, A_c R_c^{2/3}}\right]^2$

Mildest Slope in Spillway, $S = 6''/36' = 0.014$

for $y = 1$,

$A = 37.2$
$T = 41.4$
$Q = 201$

$$S_c = \left[\frac{201\ (0.02)}{1.49\ (37.2)\ (0.89)^{2/3}}\right]^2 = 0.006$$

$S > S_c$ O.K.

for $y = .5$,

$A = 269.5$
$T = 74.8$
$Q = 2911.7$

$$S_c = \left[\frac{2911.7\ (0.02)}{1.49\ (269.5)(3.55)^{2/3}}\right]^2 = 0.004$$

$S > S_c$ O.K.

∴ The assumption of critical depth at the spillway crest is valid.

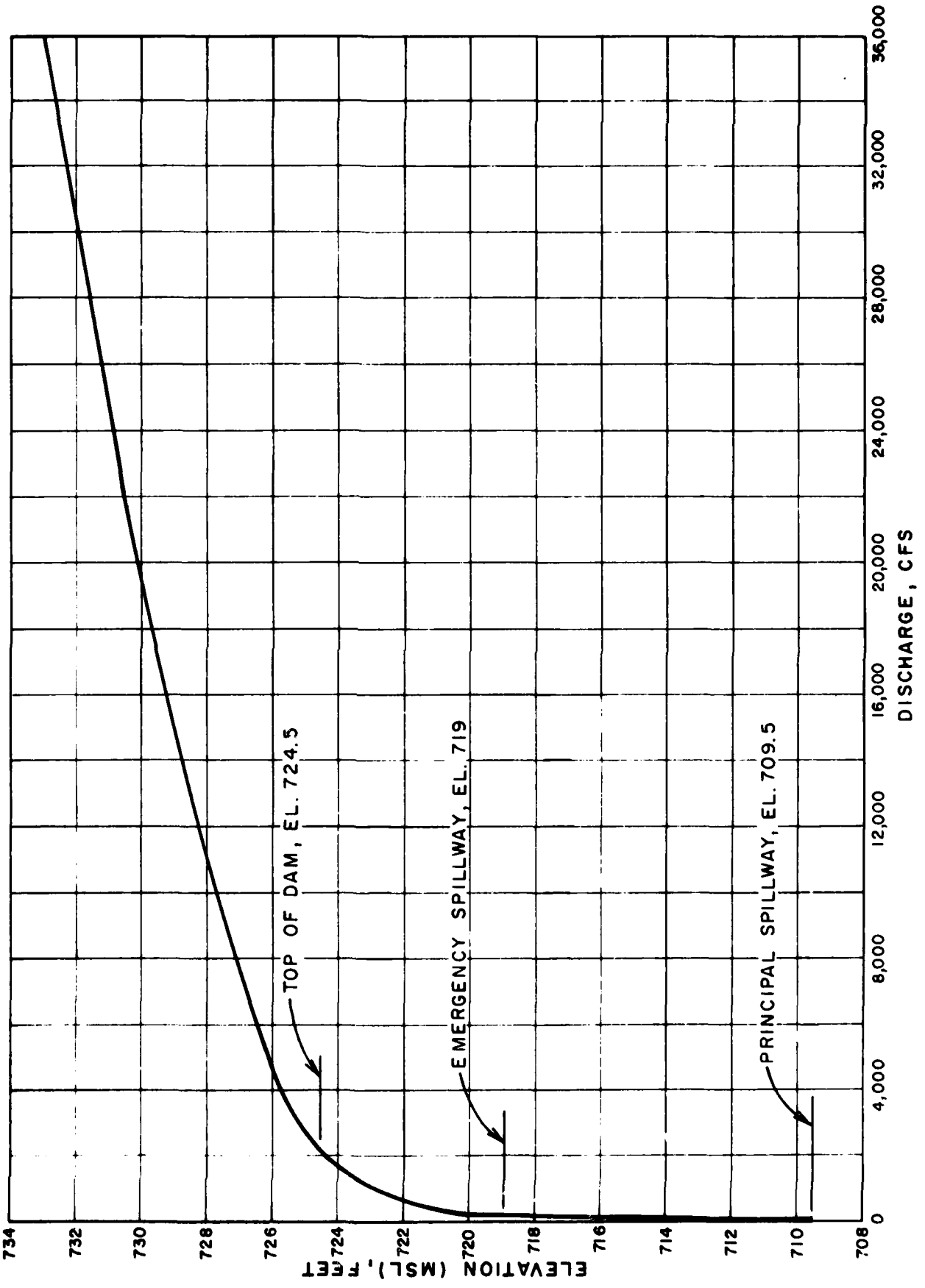
ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. 1 OF 1
GENTRY LAKE DAM (MO 10213) — JOB NO. 1263
COMBINED RATING CURVE — BY JFK DATE 5/14/80

COMBINED SPILLWAYS AND OVERTOP RATING CURVE, TABULATION

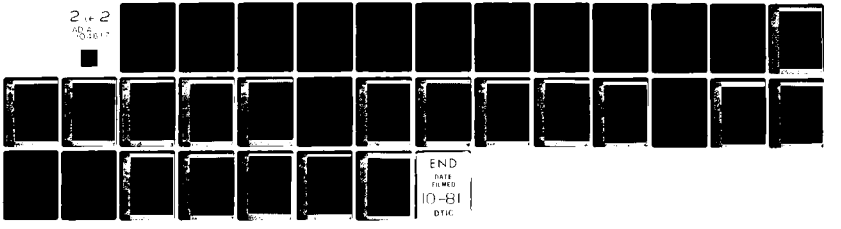
RESERVOIR WATER SURFACE ELEVATION	PRINCIPAL SPILLWAY DISCHARGE	EMERGENCY SPILLWAY AND OVERTOP DISCHARGE	COMBINED DISCHARGE
709.5	0	0	0
710.0	11	0	11
710.2	19	0	19
710.5	26	0	26
711.0	26	0	26
715.0	29	0	29
719.0	32	0	32
720.0	33	135	168
720.5	33	201	234
721.8	34	604	638
723.2	35	1188	1223
724.5	36	1949	1985
725.1	36	2900	2936
725.8	36	4477	4513
726.5	37	6448	6485
727.0	37	7946	7983
729.5	39	17176	17215
734.3	41	43024	43065

PLATE 2, APPENDIX B



GENTRY LAKE DAM (MO. 10213)
SPILLWAY & OVERTOP RATING CURVE

AD-A104 617 CONSOER TOWNSEND AND ASSOCIATES LTD ST LOUIS MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. GENTRY LAKE DAM (MO 10213), MISSIS--ETC(U)
JUL 80 W G SHIFRIN DACW43-80-C-0094
UNCLASSIFIED NL



ETI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INVESTIGATION/MISSOURI DEPT. SHEET NO. 1 OF 1

GENTRY LAKE DAM JOB NO. 1263

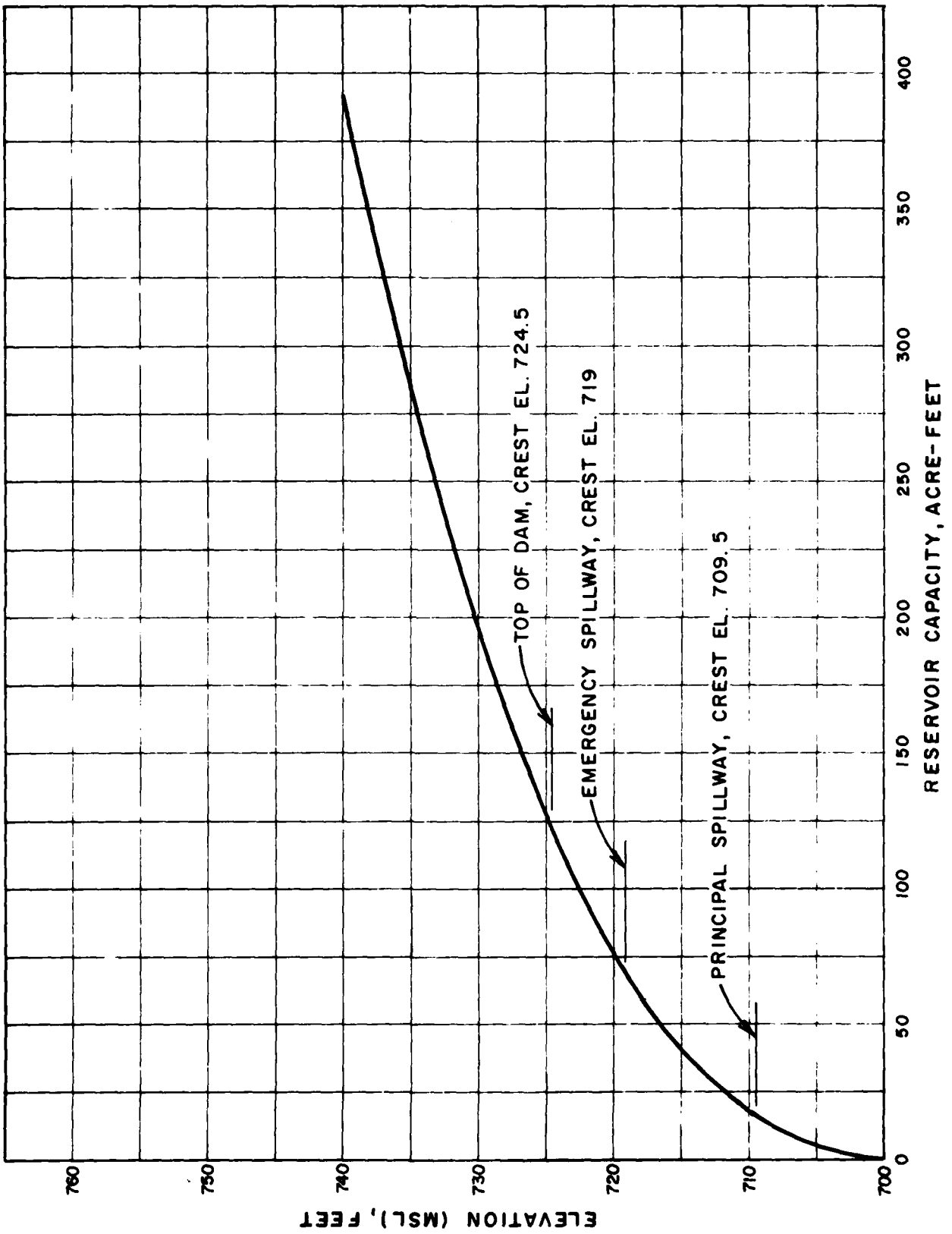
RESERVOIR AREA CAPACITY TABLE BY MAS DATE 5-1-80

GENTRY LAKE DAM

RESERVOIR ELEV. AREA CAPACITY TABLE

Elevation (M.S.L) Ft.	Reservoir Area (Acres)	Cumulative Storage (Ac. Ft.)	Remarks
700	0	0	
704.2	1.58	3.32	→ Data from SCS Drawings
707.2	2.62	9.62	
709.5	3.48	16.64	Principal Spillway Crest
710.2	3.92	19.20	
713.5	5.19	34.03	Data from SCS Drawings
716.0	6.38	48.51	
719.0	7.90	69.93	Interpolated values at Emergency Spillway Crest
720.0	8.40	78.11	
722.0	9.85	96.36	Data from SCS DWG.
724.5	11.70	123.0	Extrapolated area & capacity at top of dam
740	23	392	Area at El 740 is from USGS topo map.

PLATE 3, APPENDIX B



GENTRY LAKE DAM (MO. 10213)
RESERVOIR CAPACITY CURVE

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI - 1980 SHEET NO. 1 OF 1

DAM NAME: GENTRY LAKE DAM (MO10213) JOB NO. 1263

PROBABLE MAXIMUM PRECIPITATION BY JFK DATE 5/1/80

DETERMINATION OF PMP

1) Determine drainage area of the basin

D.A. = 0.29 sq. mi.

2) Determine PMP Index Rainfall (for D.A. = 200 sq. mi. & 24 hr. duration)

Location of centroid of basin,

Long. = 90° 50' 18" Lat. = 39° 06' 37"

PMP = 24.7" (from Fig. 1, HMR 33)

Zone = 7

3) Determine basin rainfall in terms of percentage of PMP Index Rainfall for various durations. (from Fig. 2, HMR 33)

Duration (Hrs.)	Percent of Index Rainfall (%)	Total Rainfall (Inches)	Rainfall Increments (Inches)	Duration of Increment (Hrs.)
6	100	24.7	24.7	6
12	120	29.6	4.9	6
24	130	32.1	2.5	12

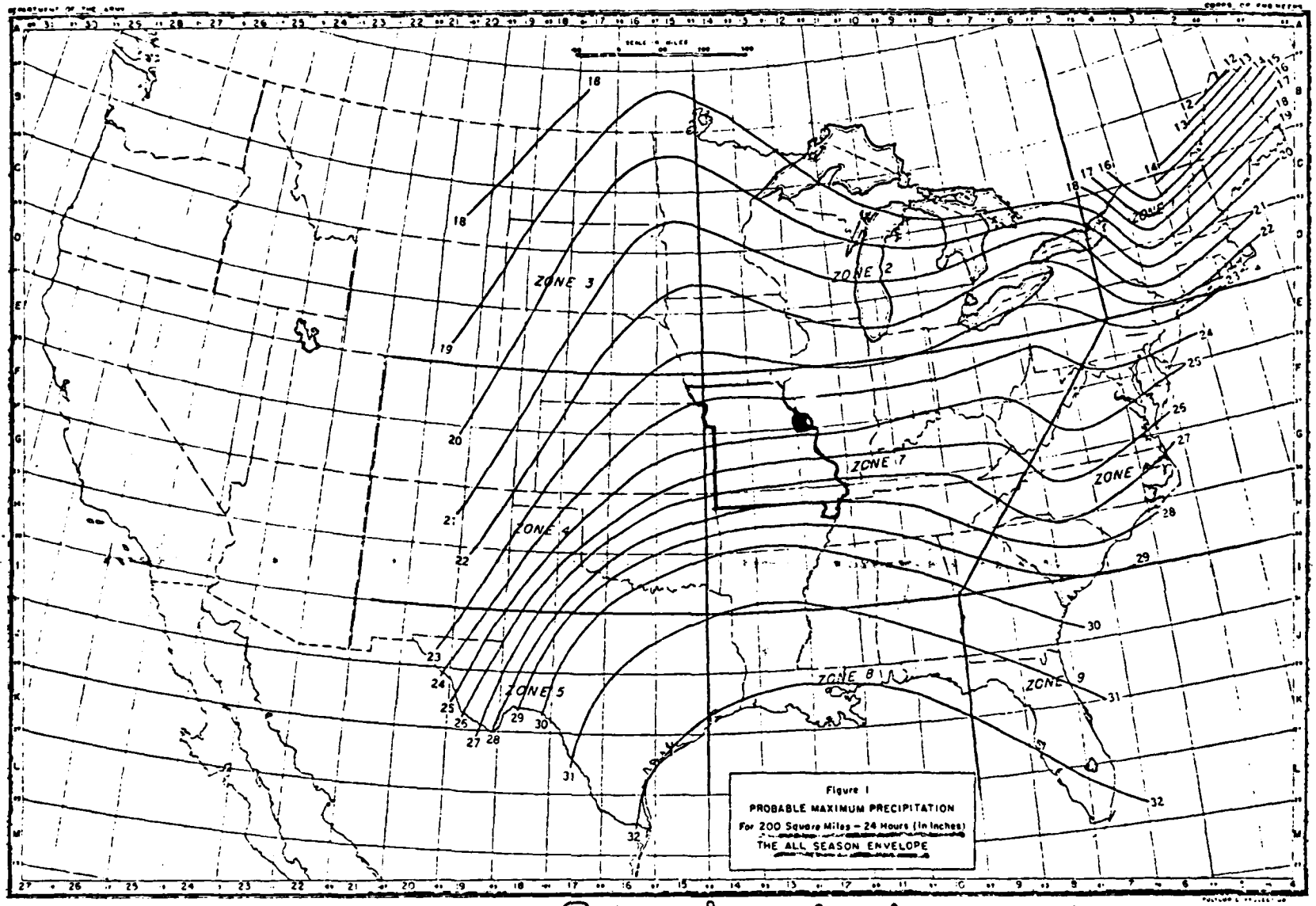


Figure 1
PROBABLE MAXIMUM PRECIPITATION
For 200 Square Miles – 24 Hours (In Inches)
THE ALL SEASON ENVELOPE

⊗ Location of Centroid of Basin

GENTRY LAKE DAM

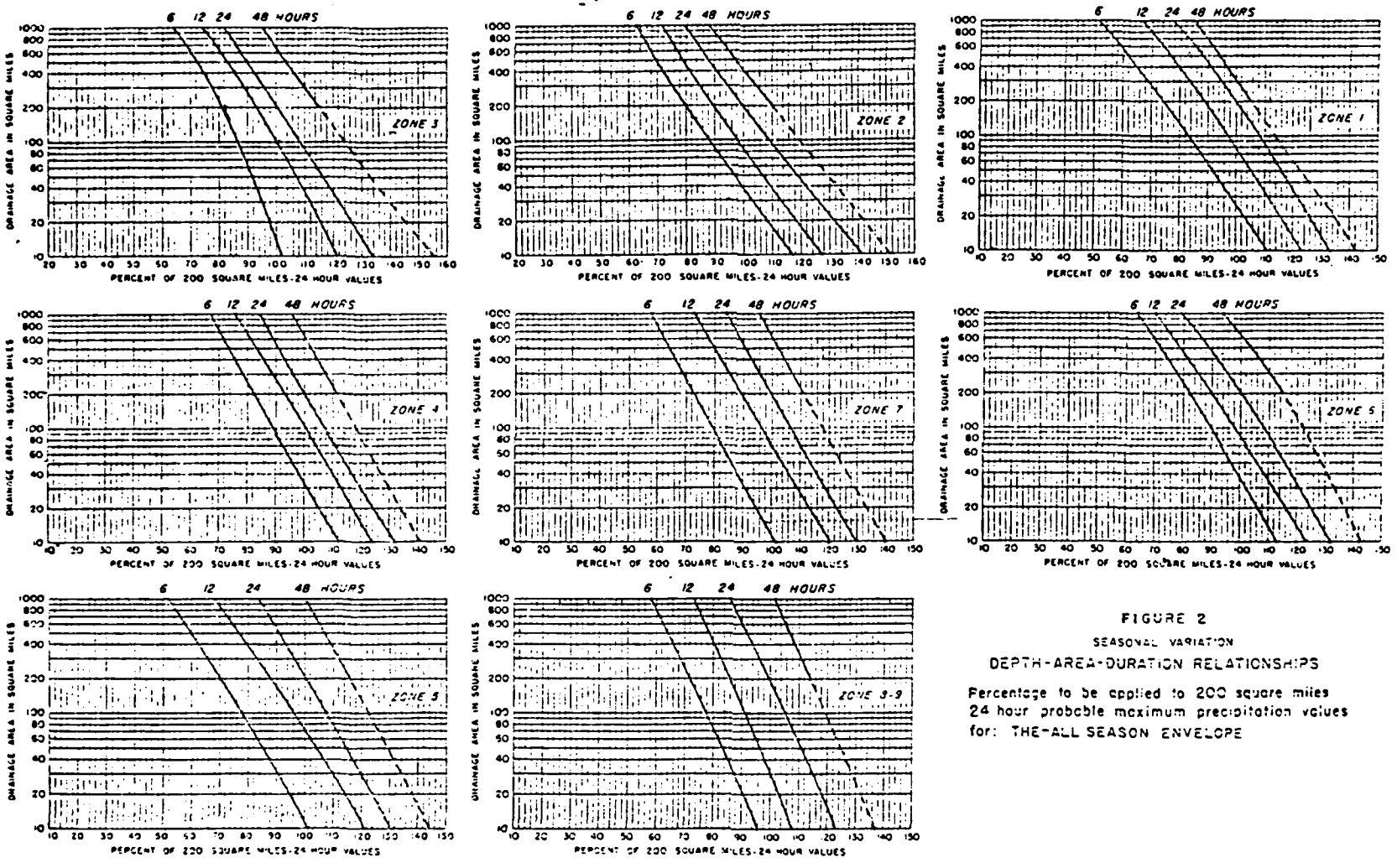


FIGURE 2

SEASONAL VARIATION

DEPTH-AREA-DURATION RELATIONSHIPS

Percentage to be applied to 200 square miles 24 hour probable maximum precipitation values for: THE-ALL SEASON ENVELOPE

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI - 1980 SHEET NO. 1 OF 1

DAM NAME: GENTRY LAKE DAM (MO 10213) JOB NO. 1263

UNIT HYDROGRAPH PARAMETERS BY JFK DATE 5/1/80

1) DRAINAGE AREA, $A = 0.29$ sq. mi $= (182.5$ acres)

2) LENGTH OF STREAM, $L = (1.4'' \times 2000' = 2800') = 0.53$ mi.

3) ELEVATION AT DRAINAGE DIVIDE ALONG THE LONGEST STREAM,

$H_1 = 900'$

4) ELEVATION OF RESERVOIR AT SPILLWAY CREST, $H_2 = 709.5'$

5) ELEVATION OF CHANNEL BED AT 0.85L, $E_{85} = 860'$

6) ELEVATION OF CHANNEL BED AT 0.10L, $E_{10} = 715'$

7) AVERAGE SLOPE OF THE CHANNEL, $S_{AVG} = (E_{85} - E_{10})/0.75L = 860 - 715/2100 = 0.069$

8) TIME OF CONCENTRATION:

A) BY KIRPICH'S EQUATION,

$t_c = [(11.9 \times L^3)/(H_1 - H_2)]^{0.385} = [11.9 \times (0.53)^3/(900 - 709.5)]^{0.385} = 0.17$ hr.

B) BY VELOCITY ESTIMATE,

SLOPE $= 0.069 \Rightarrow$ AVG. VELOCITY $= 5$ fps

$t_c = L/V = 2800/(5 \times 3600) = 0.16$ hr

USE $t_c = 0.17$ hr

9) LAG TIME, $t_l = 0.6\, t_c = 0.6\,(0.17) = 0.10$ hr

10) UNIT DURATION, $D \leq t_l/3 = 0.10/3 = 0.033 < 0.083$ hr.

USE $D = 0.083$ hr

11) TIME TO PEAK, $T_p = D/2 + t_l = 0.083/2 + 0.10 = 0.14$ hr

12) PEAK DISCHARGE,

$q_p = (484 \times A)/T_p = 484 \times 0.29/0.14 = 1003$ cfs

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. 1 OF 1

DAM NAME: GENTRY LAKE DAM (MO 10213) — JOB NO. 1263

CURVE NUMBER DETERMINATION — BY JFK — DATE 5/1/80

I) SOIL GROUP

WATERSHED SOILS IN THE BASIN CONSIST OF GROUP A (B) (C) D.

GROUP C SOILS PREDOMINATE THE BASIN. THEREFORE, ASSUME GROUP C SOILS FOR THE ENTIRE WATERSHED FOR HYDROLOGIC PURPOSES.

II) COVER COMPLEX

ASSUMED HYDROLOGIC CONDITION OF THE WATERSHED: FAIR

LAND USE	PER CENT AREA	CN (AMC II)
WOODS	75	73
PASTURE OR RANGE	25	79

III) CURVE NUMBER

WEIGHTED AVERAGE CN = 75 FOR AMC II

CURVE NUMBER = 88 FOR AMC III

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI - 1980 SHEET NO. 1 OF 1

GENTRY LAKE L... (MO 10213) JOB NO. 1263

STARTING WATER SURFACE ELEVATION FOR PMF BY JFK DATE 5/15/80

$S_i - S_f = \bar{Q} \Delta t$

$S_i - S_f / \bar{Q} = \Delta t$

$ELEV_i$ (ft)	$ELEV_f$ (ft)	S_i (ac-ft)	S_f (ac-ft)	ΔS (ac-ft)	$\bar{Q}$ (cfs)	Δt (hrs)
718.5	717	67	56	11	31	4.3
717	715	56	43	13	30	5.2
715	713	43	32	11	28.5	4.7
713	711	32	23	11	27	4.9
711	7195	23	21	2	26	0.9
710.5	709.5	21	17	4	11	4.4
						$\Sigma = 24.4$ hrs

TIME AT END OF INFLOW = 24.25 hrs ; TOTAL TIME = 24.4 hrs. + 24.25 hrs = 48.65 hrs

= 2 days < 4 days

IF THE ½ PMF PRECEDES THE PMF BY 4 DAYS, THE RESERVOIR POOL WILL HAVE DRAINED TO THE LEVEL OF THE PRINCIPAL SPILLWAY WITHIN THAT TIME. THEREFORE, START THE PMF ROUTING AT THE PRINCIPAL SPILLWAY CREST ELEVATION.

HEC1DB INPUT DATA

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  28 FEB 79
**********************************
    1                 J1                          DAM SAFETY INSPECTION - MISSOURI
    2                 J2                             GENTRY LAKE DAM (MO 10213)
    3                 J3                             PMF AND 50 PERCENT PMF
    4                 I      300        0         5         0         0         0         0         0         0         0
    5                 I1       5
    6                 J        1         2         1
    7                 J1       1       .5
    8                 K        0 MO10213                                                  1
    9                 K1  INPUT PRECIPITATION INDEX,RATIOS, AND UNIT HYDROGRAPH PARAMETERS
   10                 P        1         2      .29                .29         1
   11                 P                24.7       100       120       130
   12                 T                                                                -1       -88
   13                 T2               .1
   14                 K        0         0         1
   15                 K        1 MO10213                                0         0         1
   16                 K1  ROUTE HYDROGRAPH THROUGH GENTRY LAKE DAM (NO 10213)
   17                 Y                                            1         1
   18                 Y1       1                                                      -709.5        -1
   19                 Y4   709.5       710     710.2     710.5       711       715       719       720     720.5     721.8
   20                 Y4   723.2     724.5     725.1     725.8     726.5       727     729.5     734.3
   21                 YE       0        11        19        26        26        29        32       168       234       638
   22                 Y5    1223      1985      2936      4513      6485      7983     17215     43065
   23                 YS       0      3.32      5.62     10.64      15.2     34.03     48.51     69.93     78.11     96.36
   24                 YS     123       392
   25                 YE     700       704.2     707.2     709.5     710.2     713.5       716       719       720       722
   26                 YC   724.5       740
   27                 YS   709.5
   28                 YD   724.5
   29                 K       99
```

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT C10213
ROUTE HYDROGRAPH TO C10213
END OF NETWORK

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN DATE= 82/05/10.
     TIME= 08:45:27.
```

DAM SAFETY INSPECTION - MISSOURI
CENTRY LAKE DAM (MO 10213)
PMF AS 50 PERCENT PMF

JO SPECIFICATION

NQ	NDA	NDAY	IWAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
200	0	1	0	0	0	0	0	0	0

IOPT	LRT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 1.00 .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INPUT PRECIPITATION INDEX,RATIOS, AND UNIT HYDROGRAPH PARAMETERS

ISTA	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
01213	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.29	0.00	.94	1.00	0.000	1	0	0

PRECIP DATA

SPFE	PAS	R6	R12	R24	R48	R72	R96
0.00	24.70	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-NN.00	0.00	0.00

CURVE NO = -NN.00 WETNESS = -1.00 EFFECT CN = NN.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .10

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

TIME INCREMENT TOO LARGE--(NM. IS .1 LAG/2)

UNIT HYDROGRAPH 8 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .10 VOL= 1.00

	695.	940.	413.	160.	61.	24.	10.	3.

END-OF-PERIOD FLOW

HO.	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.35	151	.21	.20	.01	449.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.40	152	.21	.20	.01	450.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.45	153	.21	.20	.00	450.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.50	154	.21	.20	.00	451.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.55	155	.21	.20	.00	451.
1.01	.30	6	.01	0.00	.01	0.	1.01	13.00	156	.21	.20	.00	452.
1.01	.35	7	.01	0.00	.01	0.	1.01	13.05	157	.25	.24	.00	478.
1.01	.40	8	.01	0.00	.01	0.	1.01	13.10	158	.25	.24	.00	516.
1.01	.45	9	.01	0.00	.01	0.	1.01	13.15	159	.25	.24	.00	533.
1.01	.50	10	.01	0.00	.01	0.	1.01	13.20	160	.25	.24	.00	540.
1.01	.55	11	.01	0.00	.01	0.	1.01	13.25	161	.25	.24	.00	543.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.30	162	.25	.24	.00	545.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.35	163	.25	.24	.00	545.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.40	164	.25	.24	.00	546.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.45	165	.25	.24	.00	546.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.50	166	.25	.24	.00	547.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.55	167	.25	.24	.00	547.
1.01	1.30	18	.01	0.00	.01	0.	1.01	14.00	168	.25	.24	.00	547.
1.01	1.35	19	.01	0.00	.01	0.	1.01	14.05	169	.31	.31	.00	586.
1.01	1.40	20	.01	0.00	.01	0.	1.01	14.10	170	.31	.31	.00	644.
1.01	1.45	21	.01	0.00	.01	0.	1.01	14.15	171	.31	.31	.00	670.
1.01	1.50	22	.01	0.00	.01	0.	1.01	14.20	172	.31	.31	.00	680.
1.01	1.55	23	.01	0.00	.01	0.	1.01	14.25	173	.31	.31	.00	684.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.30	174	.31	.31	.00	685.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.35	175	.31	.31	.00	686.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.40	176	.31	.31	.00	687.
1.01	2.15	27	.01	0.00	.01	0.	1.01	14.45	177	.31	.31	.00	687.
1.01	2.20	28	.01	0.00	.01	0.	1.01	14.50	178	.31	.31	.00	687.
1.01	2.25	29	.01	0.00	.01	0.	1.01	14.55	179	.31	.31	.00	688.
1.01	2.30	30	.01	0.00	.01	0.	1.01	15.00	180	.31	.31	.00	693.
1.01	2.35	31	.01	0.00	.01	0.	1.01	15.05	181	.19	.19	.00	712.
1.01	2.40	32	.01	0.00	.01	0.	1.01	15.10	182	.38	.37	.00	417.
1.01	2.45	33	.01	0.00	.01	0.	1.01	15.15	183	.38	.37	.00	743.
1.01	2.50	34	.01	0.00	.01	0.	1.01	15.20	184	.56	.56	.00	919.
1.01	2.55	35	.01	0.00	.01	0.	1.01	15.25	185	.86	.85	.00	1177.
1.01	3.00	36	.01	0.00	.01	0.	1.01	15.30	186	1.60	1.59	.01	1943.
1.01	3.05	37	.01	0.00	.01	0.	1.01	15.35	187	2.67	2.66	.01	3546.
1.01	3.10	38	.01	0.00	.01	0.	1.01	15.40	188	1.03	1.03	.00	3919.
1.01	3.15	39	.01	0.00	.01	0.	1.01	15.45	189	.66	.65	.00	2775.
1.01	3.20	40	.01	0.00	.01	0.	1.01	15.50	190	.56	.56	.00	1935.
1.01	3.25	41	.01	0.00	.01	0.	1.01	15.55	191	.38	.37	.00	1406.
1.01	3.30	42	.01	0.00	.01	0.	1.01	16.00	192	.38	.37	.00	1064.
1.01	3.35	43	.01	0.00	.01	0.	1.01	16.05	193	.29	.29	.00	873.
1.01	3.40	44	.01	0.00	.01	0.	1.01	16.10	194	.29	.29	.00	754.
1.01	3.45	45	.01	0.00	.01	0.	1.01	16.15	195	.29	.29	.00	676.
1.01	3.50	46	.01	0.00	.01	0.	1.01	16.20	196	.29	.29	.00	656.
1.01	3.55	47	.01	0.00	.01	0.	1.01	16.25	197	.29	.29	.00	649.
1.01	4.00	48	.01	0.00	.01	0.	1.01	16.30	198	.29	.29	.00	646.
1.01	4.05	49	.01	0.00	.01	0.	1.01	16.35	199	.29	.29	.00	645.
1.01	4.10	50	.01	0.00	.01	0.	1.01	16.40	200	.29	.29	.00	645.
1.01	4.15	51	.01	0.00	.01	0.	1.01	16.45	201	.29	.29	.00	645.
1.01	4.20	52	.01	0.00	.01	0.	1.01	16.50	202	.29	.29	.00	645.
1.01	4.25	53	.01	0.00	.01	0.	1.01	16.55	203	.29	.29	.00	645.
1.01	4.30	54	.01	0.00	.01	0.	1.01	17.00	204	.29	.29	.00	645.
1.01	4.35	55	.01	0.00	.01	0.	1.01	17.05	205	.23	.23	.00	606.

1.01	4.40	56	.01	.01	.01	14.	1.01	17.15	206	.23	.23	.00	548.
1.01	4.45	57	.01	.01	.01	14.	1.01	17.20	207	.23	.23	.00	523.
1.01	4.50	58	.01	.01	.01	14.	1.01	17.25	208	.23	.23	.00	513.
1.01	4.55	59	.01	.01	.01	15.	1.01	17.30	209	.23	.23	.00	509.
1.01	5.00	60	.01	.01	.01	15.	1.01	17.35	210	.23	.23	.00	508.
1.01	5.05	61	.01	.01	.01	15.	1.01	17.40	211	.23	.23	.00	507.
1.01	5.10	62	.01	.01	.01	15.	1.01	17.45	212	.23	.23	.00	507.
1.01	5.15	63	.01	.01	.01	15.	1.01	17.50	213	.23	.23	.00	507.
1.01	5.20	64	.01	.01	.01	15.	1.01	17.55	214	.23	.23	.00	507.
1.01	5.25	65	.01	.01	.01	15.	1.01	18.00	215	.23	.23	.00	507.
1.01	5.30	66	.01	.01	.01	15.	1.01	18.05	216	.23	.23	.00	507.
1.01	5.35	67	.01	.01	.01	15.	1.01	18.05	217	.02	.02	.00	377.
1.01	5.40	68	.01	.01	.01	16.	1.01	18.10	218	.02	.02	.00	164.
1.01	5.45	69	.01	.01	.01	17.	1.01	18.15	219	.02	.02	.00	99.
1.01	5.50	70	.01	.01	.01	17.	1.01	18.20	220	.02	.02	.00	76.
1.01	5.55	71	.01	.01	.01	17.	1.01	18.25	221	.02	.02	.00	64.
1.01	6.00	72	.01	.01	.01	17.	1.01	18.30	222	.02	.02	.00	55.
1.01	6.05	73	.01	.01	.01	17.	1.01	18.35	223	.02	.02	.00	47.
1.01	6.10	74	.01	.01	.01	69.	1.01	18.40	224	.02	.02	.00	46.
1.01	6.15	75	.01	.01	.01	85.	1.01	18.45	225	.02	.02	.00	46.
1.01	6.20	76	.01	.01	.01	94.	1.01	18.50	226	.02	.02	.00	46.
1.01	6.25	77	.01	.01	.01	99.	1.01	18.55	227	.02	.02	.00	46.
1.01	6.30	78	.01	.01	.01	104.	1.01	19.00	228	.02	.02	.00	46.
1.01	6.35	79	.01	.01	.01	106.	1.01	19.05	229	.02	.02	.00	46.
1.01	6.40	80	.01	.01	.01	109.	1.01	19.1	230	.02	.02	.00	46.
1.01	6.45	81	.01	.01	.01	111.	1.01	19.15	231	.02	.02	.00	46.
1.01	6.50	82	.01	.01	.01	113.	1.01	19.20	232	.02	.02	.00	46.
1.01	6.55	83	.01	.01	.01	115.	1.01	19.25	233	.02	.02	.00	46.
1.01	7.00	84	.01	.01	.01	117.	1.01	19.30	234	.02	.02	.00	46.
1.01	7.05	85	.01	.01	.01	119.	1.01	19.35	235	.02	.02	.00	46.
1.01	7.10	86	.01	.01	.01	120.	1.01	19.40	236	.02	.02	.00	46.
1.01	7.15	87	.01	.01	.01	122.	1.01	19.45	237	.02	.02	.00	46.
1.01	7.20	88	.01	.01	.01	123.	1.01	19.50	238	.02	.02	.00	46.
1.01	7.25	89	.01	.01	.01	125.	1.01	19.55	239	.02	.02	.00	46.
1.01	7.30	90	.01	.01	.01	126.	1.01	20.00	240	.02	.02	.00	46.
1.01	7.35	91	.01	.01	.01	127.	1.01	20.05	241	.02	.02	.00	46.
1.01	7.40	92	.01	.01	.01	128.	1.01	20.10	242	.02	.02	.00	46.
1.01	7.45	93	.01	.01	.01	129.	1.01	20.15	243	.02	.02	.00	46.
1.01	7.50	94	.01	.01	.01	130.	1.01	20.20	244	.02	.02	.00	46.
1.01	7.55	95	.01	.01	.01	131.	1.01	20.25	245	.02	.02	.00	46.
1.01	8.00	96	.01	.01	.01	132.	1.01	20.30	246	.02	.02	.00	46.
1.01	8.05	97	.01	.01	.01	133.	1.01	20.35	247	.02	.02	.00	46.
1.01	8.10	98	.01	.01	.01	134.	1.01	20.40	248	.02	.02	.00	46.
1.01	8.15	99	.01	.01	.01	134.	1.01	20.45	249	.02	.02	.00	46.
1.01	8.20	100	.01	.01	.01	135.	1.01	20.50	250	.02	.02	.00	46.
1.01	8.25	101	.01	.01	.01	136.	1.01	20.55	251	.02	.02	.00	46.
1.01	8.30	102	.01	.01	.01	136.	1.01	21.00	252	.02	.02	.00	46.
1.01	8.35	103	.01	.01	.01	137.	1.01	21.05	253	.02	.02	.00	46.
1.01	8.40	104	.01	.01	.01	137.	1.01	21.10	254	.02	.02	.00	46.
1.01	8.45	105	.01	.01	.01	138.	1.01	21.15	255	.02	.02	.00	46.
1.01	8.50	106	.01	.01	.01	138.	1.01	21.20	256	.02	.02	.00	46.
1.01	8.55	107	.01	.01	.01	139.	1.01	21.25	257	.02	.02	.00	46.
1.01	9.00	108	.01	.01	.01	139.	1.01	21.3	258	.02	.02	.00	46.
1.01	9.05	109	.01	.01	.01	140.	1.01	21.35	259	.02	.02	.00	46.
1.01	9.10	110	.01	.01	.01	140.	1.01	21.40	260	.02	.02	.00	46.
1.01	9.15	111	.01	.01	.01	141.	1.01	21.45	261	.02	.02	.00	46.
1.01	9.20	112	.01	.01	.01	141.	1.01	21.50	262	.02	.02	.00	46.
1.01	9.25	113	.01	.01	.01	141.	1.01	21.55	263	.02	.02	.00	46.
1.01	9.30	114	.01	.01	.01	142.	1.01	22.00	264	.02	.02	.00	46.
1.01	9.35	115	.01	.01	.01	142.	1.01	22.05	265	.02	.02	.00	46.

1.01	9.40	116	.07	.06	.00	142.	1.01	20.10	266	.02	.02	.00	46.
1.01	9.45	117	.07	.06	.00	143.	1.01	20.15	267	.02	.02	.00	46.
1.01	9.50	118	.07	.06	.00	143.	1.01	20.20	268	.02	.02	.00	46.
1.01	9.55	119	.07	.06	.00	143.	1.01	20.25	269	.02	.02	.00	46.
1.01	10.00	120	.07	.06	.00	144.	1.01	20.30	270	.02	.02	.00	46.
1.01	10.05	121	.07	.06	.00	144.	1.01	20.35	271	.02	.02	.00	46.
1.01	10.10	122	.07	.06	.00	144.	1.01	20.40	272	.02	.02	.00	46.
1.01	10.15	123	.07	.06	.00	144.	1.01	20.45	273	.02	.02	.00	46.
1.01	10.20	124	.07	.06	.00	145.	1.01	20.50	274	.02	.02	.00	46.
1.01	10.25	125	.07	.06	.00	145.	1.01	20.55	275	.02	.02	.00	46.
1.01	10.30	126	.07	.06	.00	145.	1.01	21.00	276	.02	.02	.00	46.
1.01	10.35	127	.07	.06	.00	145.	1.01	21.05	277	.02	.02	.00	46.
1.01	10.40	128	.07	.06	.00	145.	1.01	21.10	278	.02	.02	.00	46.
1.01	10.45	129	.07	.07	.00	146.	1.01	21.15	279	.02	.02	.00	46.
1.01	10.50	130	.07	.07	.00	146.	1.01	21.20	280	.02	.02	.00	46.
1.01	10.55	131	.07	.07	.00	146.	1.01	21.25	281	.02	.02	.00	46.
1.01	11.00	132	.07	.07	.00	146.	1.01	21.30	282	.02	.02	.00	46.
1.01	11.05	133	.07	.07	.00	146.	1.01	21.35	283	.02	.02	.00	46.
1.01	11.10	134	.07	.07	.00	146.	1.01	21.40	284	.02	.02	.00	46.
1.01	11.15	135	.07	.07	.00	147.	1.01	21.45	285	.02	.02	.00	46.
1.01	11.20	136	.07	.07	.00	147.	1.01	21.50	286	.02	.02	.00	46.
1.01	11.25	137	.07	.07	.00	147.	1.01	21.55	287	.02	.02	.00	46.
1.01	11.30	138	.07	.07	.00	147.	1.02	22.00	288	.02	.02	.00	46.
1.01	11.35	139	.07	.07	.00	147.	1.02	.05	289	0.00	0.00	0.00	23.
1.01	11.40	140	.07	.07	.00	147.	1.02	.10	290	0.00	0.00	0.00	14.
1.01	11.45	141	.07	.07	.00	148.	1.02	.15	291	0.00	0.00	0.00	5.
1.01	11.50	142	.07	.07	.00	148.	1.02	.20	292	0.00	0.00	0.00	2.
1.01	11.55	143	.07	.07	.00	148.	1.02	.25	293	.00	0.00	0.00	1.
1.01	12.00	144	.07	.07	.00	148.	1.02	.30	294	.00	0.00	0.00	0.
1.01	12.05	145	.07	.07	.01	235.	1.02	.35	295	0.00	0.00	0.00	0.
1.01	12.10	146	.21	.20	.01	367.	1.02	.40	296	0.00	0.00	0.00	0.
1.01	12.15	147	.21	.20	.01	410.	1.02	.45	297	0.00	0.00	0.00	0.
1.01	12.20	148	.21	.20	.01	434.	1.02	.50	298	0.00	0.00	0.00	0.
1.01	12.25	149	.21	.20	.01	443.	1.02	.55	299	0.00	0.00	0.00	0.
1.02	12.30	150	.21	.20	.01	447.	1.02	1.00	300	0.00	0.00	0.00	0.

SUM	30.11	30.53	1.68	68515.
	(765.)	(775.)	(43.)	(1940.13)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5917.	4[illegible].	2[illegible].	228.	[illegible].
CMS	111.	21.	7.	[illegible].	1940.
INCHES		24.13	30.53	30.53	30.53
MM		613.[illegible]	775.45	775.45	775.45
AC-FT		376.	4726	[illegible].	[illegible].
THOUS CU M		464.	583.	583.	583.

HYDROGRAPH AT ST401[illegible]21[illegible] FOR PLAN 1, ATIC 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	2.	3.	3.	4.	4.	5.
5.	6.	6.	6.	7.	7.	8.	8.	9.	9.
9.	10.	10.	10.	11.	11.	11.	12.	12.	12.
12.	13.	13.	13.	14.	14.	14.	14.	15.	15.
15.	15.	15.	16.	16.	16.	16.	16.	17.	17.
17.	17.	94.	95.	95.	96.	99.	103.	106.	108.
111.	113.	115.	117.	119.	120.	122.	123.	125.	126.
127.	128.	129.	130.	131.	132.	133.	134.	134.	135.

136.	136.	137.	137.	138.	138.	139.	139.	140.	140.
141.	141.	141.	142.	142.	142.	143.	143.	143.	144.
144.	144.	144.	145.	145.	145.	145.	146.	146.	146.
146.	146.	146.	147.	147.	147.	147.	147.	147.	147.
149.	149.	149.	149.	229.	317.	412.	434.	443.	447.
449.	450.	450.	451.	451.	452.	479.	516.	533.	540.
547.	548.	548.	548.	546.	547.	547.	547.	586.	644.
670.	680.	680.	680.	684.	687.	687.	647.	684.	688.
612.	617.	747.	919.	1147.	1943.	3044.	3919.	2778.	1935.
1068.	1068.	877.	734.	650.	650.	640.	646.	649.	645.
645.	645.	645.	645.	645.	645.	523.	513.	500.	509.
507.	507.	507.	507.	507.	507.	477.	1[illegible].	91.	66.
54.	49.	47.	46.	46.	46.	46.	46.	46.	46.
46.	46.	46.	46.	46.	46.	46.	46.	46.	46.
46.	46.	46.	46.	46.	46.	46.	46.	46.	46.
46.	46.	46.	46.	46.	46.	46.	46.	46.	46.
46.	46.	46.	46.	46.	46.	46.	46.	46.	46.
46.	46.	46.	46.	46.	46.	46.	46.	47.	46.
46.	46.	46.	46.	46.	46.	46.	46.	24.	14.
5.	2.	1.	0.	0.	0.	0.	0.	0.	0.

	[illegible]-HOUR	[illegible]-HOUR	72-HOUR	TOTAL VOLUME
[illegible]	750.	2[illegible].	[illegible].	[illegible]527.
[illegible]	21.	7.	[illegible].	1940.
[illegible]	24.53	30.62	[illegible]	30.62
[illegible]	[illegible]	775.45	775.45	775.45
[illegible]	576.	47[illegible].	47[illegible].	472.
[illegible]	4[illegible].	58[illegible].	5[illegible].	[illegible].

[illegible] HY-[illegible]RAPH [illegible]T [illegible]A010213 FOR PLAN 1, [illegible]TION 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	2.	2.	2.	2.
3.	3.	3.	3.	3.	4.	4.	4.	4.	4.
5.	5.	5.	5.	5.	5.	6.	6.	6.	6.
6.	6.	7.	7.	7.	7.	7.	7.	7.	7.
8.	8.	8.	8.	8.	8.	8.	8.	8.	8.
9.	9.	10.	10.	47.	47.	49.	51.	53.	54.
55.	57.	58.	59.	61.	60.	61.	62.	63.	63.
64.	64.	65.	65.	65.	66.	66.	67.	67.	67.
68.	69.	69.	69.	69.	69.	69.	70.	70.	70.
70.	71.	71.	71.	71.	71.	71.	72.	72.	72.
72.	72.	72.	72.	72.	73.	73.	73.	73.	73.
73.	73.	73.	73.	73.	73.	74.	74.	74.	74.
74.	74.	74.	74.	116.	176.	2[illegible].	217.	221.	223.
224.	225.	225.	225.	226.	246.	259.	268.	267.	270.
272.	272.	273.	273.	273.	273.	273.	274.	293.	302.
335.	340.	340.	343.	343.	343.	344.	344.	344.	344.
399.	399.	371.	460.	588.	972.	1773.	1960.	1387.	967.
703.	534.	426.	367.	330.	328.	324.	323.	323.	323.
323.	323.	323.	323.	303.	274.	261.	217.	255.	254.
254.	254.	254.	254.	254.	254.	188.	92.	50.	33.
27.	24.	23.	23.	23.	23.	23.	23.	23.	23.
23.	23.	23.	23.	23.	23.	23.	23.	23.	23.
23.	23.	23.	23.	23.	23.	23.	23.	23.	23.
23.	23.	23.	23.	23.	23.	23.	23.	23.	23.
23.	23.	23.	23.	23.	23.	23.	23.	23.	23.
23.	23.	23.	23.	23.	23.	23.	23.	23.	23.

FLOOD ROUTING

23.	23.	23.	23.	23.	23.	23.	23.	17.	7.
3.	1.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	[illegible]	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	196.0.	37+.	11.+	114.	9+963.
CMS	5+.	11.	3.	3.	970.
INCHES		10.17	1+.2+	15.+4	1+.+6
MM		2+8.0+	+7+.73	3+7.73	3+7.73
AC-FT		14.	36.	236.	236.
THOUSAND M		23+.	2+1.	291.	291.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH GERRY LAKE DAM (MO 10211)

ISTAO	ICOMP	IECON	ITYP	IPLT	JPRT	INAME	ISTAGE	IAUTO
10211	1	0	1	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
.+0	0.000	0.00	1	1	0	0	0

NSTPS	NSTPL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0[illegible]	0.[illegible]	0.300	+710.	+1

STAGE	709.5[illegible]	710.0[illegible]	710.[illegible]	71[illegible].50	711.00	715.00	719.00	7[illegible].00	720.50	721.80
	723.20	724.5[illegible]	725.1[illegible]	72[illegible].80	726.50	727.00	729.50	739.30		
FLOW	[illegible].0[illegible]	11.0	1[illegible].0[illegible]	[illegible]6.0[illegible]	76.00	2[illegible].00	32.00	1[illegible]8.00	234.00	6[illegible].0[illegible]
	122[illegible].0	1[illegible]+.0[illegible]	2[illegible]76.0[illegible]	+[illegible]13.00	[illegible]+[illegible]5.00	79[illegible].00	17215.00	430[illegible].00		
CAPACITY=	0.	[illegible].	10.	17.	1[illegible].	5[illegible].	4[illegible].	73.	78.	9[illegible].
	123.	3[illegible].								
ELEVATION=	70[illegible].	7[illegible].	707.	71[illegible].	710.	71[illegible].	716.	719.	720.	722.
	725.	7[illegible].								

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
709.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

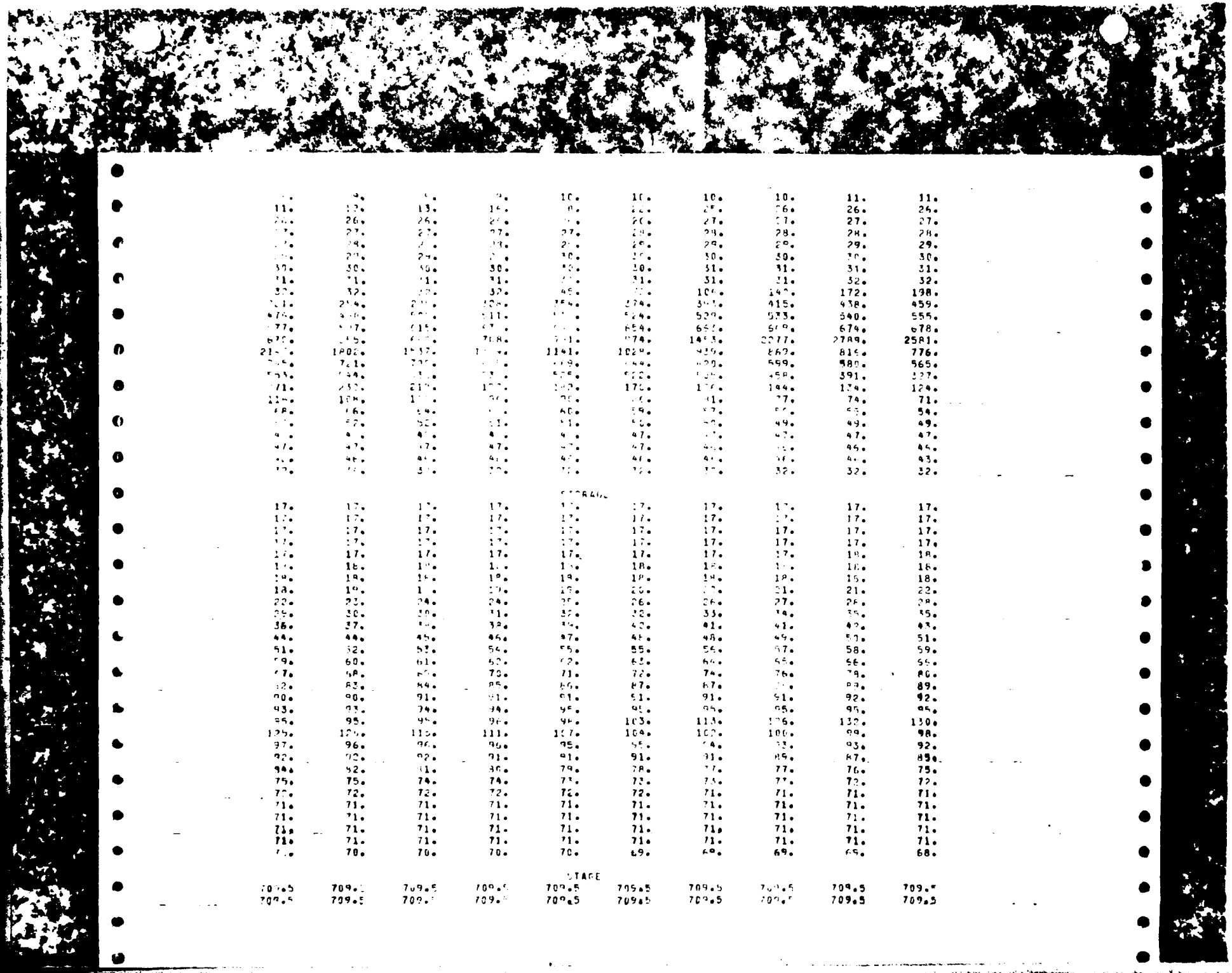
TOPEL	COOD	EXPD	DAMID
724.5	3.0	0.0	0.

STATION 10213. PLAN 1. RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	2.	2.	2.	2.	3.	3.
3.	3.	4.	4.	4.	4.	5.	5.	5.	5.
6.	6.	6.	7.	7.	7.	7.	8.	8.	8.



709.5	709.5	709.5	709.5	709.5	709.6	709.6	709.6	709.6	709.6
709.6	709.6	709.6	709.6	709.6	709.6	709.6	709.6	709.6	709.6
709.6	709.7	709.7	709.7	709.7	709.7	709.7	709.7	709.7	709.7
709.8	709.8	709.8	709.8	709.8	709.8	709.8	709.8	709.9	709.9
709.9	709.9	709.9	709.9	709.9	709.9	710.0	710.0	710.0	710.0
710.0	710.0	710.0	710.1	710.2	710.3	710.4	710.6	710.7	710.8
710.9	711.1	711.2	711.3	711.5	711.6	711.8	711.9	712.1	712.2
712.4	712.5	712.7	712.8	713.0	713.1	713.3	713.5	713.6	713.7
713.9	714.0	714.1	714.2	714.4	714.5	714.6	714.8	714.9	715.0
715.2	715.3	715.4	715.6	715.7	715.8	716.0	716.1	716.2	716.3
716.4	716.5	716.7	716.7	716.8	717.0	717.1	717.2	717.3	717.4
717.5	717.6	717.7	717.8	718.0	718.1	718.2	718.3	718.4	718.5
718.6	718.7	718.8	719.0	719.1	719.3	719.5	719.8	720.0	720.2
720.4	720.5	720.7	720.8	720.9	721.0	721.0	721.1	721.2	721.2
721.3	721.3	721.4	721.4	721.4	721.4	721.4	721.5	721.5	721.5
721.6	721.7	721.7	721.8	721.8	721.8	721.9	721.9	721.9	721.9
721.9	721.9	721.9	722.0	722.2	722.4	723.6	724.7	725.0	724.9
724.6	724.2	723.7	723.2	722.8	722.7	722.3	722.4	722.2	722.1
722.1	722.0	721.9	721.9	721.9	721.8	721.7	721.7	721.8	721.6
721.5	721.5	721.5	721.5	721.4	721.4	721.4	721.4	721.0	720.8
720.6	720.5	720.3	720.2	720.1	720.1	719.9	719.8	719.7	719.7
719.6	719.	719.5	719.5	719.4	719.4	719.4	719.3	719.3	719.2
719.3	719.2	719.2	719.2	719.2	719.2	719.2	719.2	719.2	719.2
719.2	719.2	719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1
719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1
719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1
719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1	719.1
719.1	719.	719.0	719.0	718.9	718.9	718.9	718.8	718.8	718.8

PEAK OUTFLOW IS 2756. AT TIME 13.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2756.	77[illegible].	212.	207.	61012.
CMS	79.	21.	6.	6.	1728.
INCHES		23.89	27.18	27.18	27.18
MM		593.12	690.41	690.41	690.41
AC-FT		265.	420.	420.	420.
THOUS CU M		450.	518.	518.	518.

STATION 010213, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	2.	2.	2.	3.	3.	3.
3.	3.	3.	3.	3.	4.	4.	4.	4.	4.
4.	4.	5.	5.	5.	5.	5.	5.	5.	5.
6.	6.	6.	7.	8.	10.	11.	14.	17.	19.
21.	22.	23.	24.	25.	26.	26.	26.	26.	26.
26.	26.	26.	26.	26.	26.	26.	26.	26.	26.
26.	26.	26.	26.	27.	27.	27.	27.	27.	27.
27.	27.	27.	27.	27.	27.	27.	27.	27.	27.
27.	27.	27.	27.	27.	28.	28.	28.	28.	28.

28.	28.	28.	2 .	28.	28.	28.	28.	28.	28.
28.	28.	28.	28.	28.	29.	29.	29.	29.	29.
29.	30.	30.	30.	30.	30.	30.	30.	31.	31.
31.	31.	31.	31.	32.	32.	32.	58.	82.	107.
131.	153.	173.	189.	203.	217.	229.	245.	267.	283.
292.	295.	304.	328.	369.	455.	651.	949.	1121.	1135.
1153.	954.	841.	743.	627.	573.	521.	480.	447.	421.
400.	384.	371.	361.	351.	338.	323.	310.	298.	288.
282.	276.	271.	267.	265.	262.	259.	239.	217.	200.
194.	189.	185.	183.	127.	115.	106.	97.	89.	82.
75.	70.	66.	60.	56.	52.	49.	46.	44.	42.
40.	39.	38.	38.	34.	32.	32.	32.	32.	32.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
32.	32.	32.	32.	3 .	32.	32.	32.	32.	31.

STORAGE

17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	17.	18.	18.
18.	18.	18.	18.	18.	18.	18.	19.	19.	19.
19.	20.	20.	20.	20.	21.	21.	21.	21.	22.
22.	22.	22.	23.	23.	23.	24.	24.	24.	24.
25.	25.	25.	26.	26.	26.	26.	27.	27.	27.
28.	28.	28.	28.	29.	29.	29.	30.	30.	30.
31.	31.	31.	31.	32.	32.	32.	33.	33.	33.
34.	34.	34.	35.	35.	35.	36.	36.	36.	37.
37.	37.	37.	38.	39.	39.	40.	41.	43.	44.
45.	47.	49.	49.	51.	52.	54.	55.	57.	58.
60.	62.	63.	65.	67.	69.	70.	71.	73.	74.
75.	77.	78.	80.	81.	81.	82.	83.	84.	84.
84.	84.	85.	86.	87.	89.	95.	102.	107.	107.
105.	102.	100.	97.	95.	93.	91.	90.	89.	89.
88.	87.	87.	86.	86.	86.	86.	86.	85.	84.
84.	84.	84.	84.	84.	84.	83.	83.	81.	80.
78.	78.	77.	76.	76.	75.	74.	74.	73.	73.
73.	72.	72.	72.	71.	71.	71.	71.	71.	71.
70.	70.	70.	70.	70.	70.	70.	70.	70.	70.
70.	70.	70.	69.	69.	69.	69.	69.	69.	69.
69.	69.	69.	69.	69.	69.	69.	69.	69.	69.
69.	68.	68.	68.	68.	68.	68.	68.	68.	68.
68.	68.	68.	68.	68.	68.	68.	67.	67.	67.
67.	67.	67.	66.	66.	66.	66.	66.	65.	65.

STAGE

709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5
709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5
709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.5
709.5	709.5	709.5	709.5	709.5	709.5	709.5	709.6	709.6	709.6
709.6	709.6	709.6	709.6	709.6	709.6	709.6	709.6	709.6	709.6
709.6	709.6	709.6	709.7	709.7	709.7	709.7	709.7	709.7	709.7
709.7	709.7	709.7	709.7	709.7	709.7	709.7	709.7	709.7	709.7
709.8	709.8	709.8	709.8	709.8	709.9	710.0	710.1	710.1	710.2
710.3	710.3	710.4	710.4	710.5	710.5	710.6	710.6	710.7	710.7

711.4	710.8	710.3	711.0	711.0	711.1	711.2	711.2	711.3	711.4
711.4	711.5	711.5	711.6	711.7	711.7	711.8	711.9	711.9	712.0
712.1	712.1	712.2	712.3	712.3	712.4	712.5	712.5	712.6	712.7
712.7	712.8	712.9	712.9	713.0	713.1	713.2	713.2	713.3	713.4
713.4	713.5	713.6	713.6	713.7	713.7	713.8	713.8	713.9	713.9
714.0	714.0	714.1	714.2	714.2	714.3	714.6	714.8	715.0	715.2
715.5	715.7	715.9	716.1	716.3	716.5	716.7	716.9	717.1	717.4
717.6	717.8	718.1	718.3	718.5	718.8	719.0	719.2	719.4	719.6
719.7	719.8	720.0	720.0	720.3	720.4	720.5	720.5	720.6	720.7
720.7	720.7	720.7	720.7	720.9	721.0	721.0	721.0	721.0	721.0
722.0	722.0	722.0	722.0	721.9	721.8	721.4	721.4	721.2	721.1
721.0	721.0	720.9	720.9	720.9	720.8	720.8	720.7	720.7	720.7
720.7	720.6	720.6	720.6	720.6	720.5	720.6	720.6	720.4	720.2
720.1	720.0	719.9	719.9	719.7	719.6	719.5	719.5	719.4	719.4
719.3	719.3	719.2	719.2	719.2	719.2	719.1	719.1	719.1	719.1
719.1	719.0	719.0	719.0	719.0	719.0	719.0	719.0	719.0	719.0
719.0	719.0	719.0	718.9	718.9	718.9	718.9	718.9	719.0	718.9
718.9	718.9	718.9	718.9	718.8	718.8	718.8	718.8	718.8	718.8
719.0	718.9	718.8	718.8	718.8	718.8	718.7	718.7	718.7	718.7
718.7	718.7	718.7	718.7	718.7	718.7	718.7	718.7	718.6	718.6
718.6	718.6	718.5	718.5	718.5	718.4	718.4	718.4	718.4	718.3

PEAK OUTFLOW IS 1135. AT TIME 15.[illegible] HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1135.	519.	95.	91.	27252.
CMS	32.	15.	3.	3.	771.
INCHES		10.69	12.13	12.13	12.13
MM		271.25	308.16	308.16	308.16
AC-FT		154.	1[illegible]8.	1[illegible].	1[illegible].
THOUS CU M		192.	231.	231.	231.

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SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2
				1.00	.50
HYDROGRAPH AT	OLIVE	.4	1	1,130.	1960.
		(.01)		(31.99)	(55.50)
ROUTED TO	10521	.4	1	789.	1137.
		(.01)		(22.33)	(32.19)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	7[illegible].50	709.50	724.50
STORAGE	17.	17.	123.
OUTFLOW	0.	0.	1985.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV.	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	7[illegible].01	.1	1[illegible].	2789.	.33	15.75	0.00
.50	72[illegible].[illegible]	0.00	10[illegible].	1131.	0.00	15.25	0.00

PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  28 FEB 79
**********************************
    1  A1                          DAM SAFETY INSPECTION - MISSOURI
    2  A2                             GENTRY LAKE DAM (MO 10213)
    3  A3                                  PERCENT PMF
    4  B     300       0       5       0       0       0       0       0      -4       0
    5  P1      5
    6  J       1       4       1
    7  J1    .75     .77     .78     .80
    8  K       0 MO10213                                       1
    9  K1  INPUT PRECIPITATION INDEX,RATIOS, AND UNIT HYDROGRAPH PARAMETERS
   10  A       1       2     .29             .29       1
   11  B              24.7     100     120     130
   12  T                                                  -1      -88
   13  A2              .1
   14  K       0       0       1
   15  K       1 MO10213                               0       0       1
   16  K1  ROUTE HYDROGRAPH THROUGH GENTRY LAKE DAM (MO 10213)
   17  Y                                       1       1
   18  Y1      1                                                -709.5      -1
   19  Y4  709.5     710   710.2   710.5     711     715     719     720   720.5   721.8
   20  Y4  723.2   724.5   725.1   725.8   726.5     727   729.5   734.3
   21  Y5      0      11      19      26      26      29      32     168     234     638
   22  Y5   1223    1985    2936    4513    6485    7983   17215   43065
   23  Y5      0    3.32    9.62   16.64    19.2   24.03   48.51   69.93   78.11   96.36
   24  Y5    123     392
   25  BE    700   704.2   707.2   709.5   710.2   713.5     716     719     720     722
   26  BE  724.5     740
   27  B1  709.5
   28  B2  724.5
   29  K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	010213
ROUTE HYDROGRAPH TO	010213
END OF NETWORK	

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN   DATE= 4/30/79.
      TIME= 10.21.01.
```

DA SAFETY INSPECTION - MISSOURI
SMITHVILLE LAKE DAM (MO 10214)
(SPECIFIED TYPE

JOB SPECIFICATION

NO	NWT	NXTIM	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
500	0		5	0	0	0	0	-4	0

JXMX	MUT	L OUT	TRACE
0	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1

RTIOS=	.75	.77	.7	.1

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INPUT PRECIPITATION INDEX,RATIOS, AND UNIT HYDROGRAPH PARAMETERS

ISTA	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
210217	1	0	0	0	0	1	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.24	0.00	.24	1.00	0.000			1

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.70	120.00	120.00	150.00	0.00	0.00	0.00

LOSS DATA

LKOPT	STRKS	DLTKS	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
2	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-0.00	0.00	0.00

CURVE NO = -0.00 RTIOK = -1.00 EFFECT LN = 0.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .10

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 32.11 30.73 1.51 6851.
(815.3)(775.3)(40.3)(1940.13)

HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH [illegible]

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAG	IAUTO
910013	1	0	0	0	0	1	0	0

ROUTING DATA

CLOSS	CLOSS	AVG	IRES	ISAME	IPLT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	1	0.000	0.000	0.000	-71*.	-1

STAGE	[illegible]	710.00	710.00	710.00	711.00	710.00	710.	720.00	720.50	721.00
	715.25	720.50	725.13	730.50	735.00	720.00	720.5	720.50		
FLOW	0.0	11.0	15.00	20.	26.	24.00	0.0	160.00	230.00	6[illegible].00
	1[illegible].0	1[illegible].00	2[illegible].00	4[illegible].00	7[illegible].0	1721[illegible].0	4[illegible].00			
CAPACITY	0.	0.	10.	17.	17.	74.	74.	77.	78.	96.
	193.	5[illegible].								
ELEVATION	730.	714.	717.	710.	710.	714.	714.	720.	720.	720.
	725.	740.								

CAREA	SPEED	COOL	EXPW	ELEVL	COOL	CAREA	EXPL
70.	0.0	0.0	0.0	0.0	0.0	0.0	0.0

LAG DATA

TOTL	COOL	EXPO	TIMAID
72[illegible].5	0.0	0.0	0.

PEAK OUTFLOW IS 1[illegible].48. AT TIME 1[illegible].75 HOURS

PEAK OUTFLOW IS [illegible]70.0. AT TIME 15.[illegible] HOURS

PEAK OUTFLOW IS 1934. AT TIME 1[illegible].75 HOURS

PEAK OUTFLOW IS 1996. AT TIME 15.7[illegible] HOURS

PEAK FL[illegible] AND STOR[illegible] (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC [illegible] PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .75	RATIO 2 .77	RATIO 3 .78	RATIO 4 .80
HYDROGRAPH AT	01521[illegible]	.39	1	[illegible]29.	701.	[illegible]57.	315.
		(.79)		(83.23)(	75.45)(	80.56)(	89.73)(
ROUTED [illegible]	01521[illegible]	.39	1	1[illegible]2.	1563.	1534.	1996.
		(.79)		(5[illegible].7[illegible])(	[illegible]3.5)(	54.77)(	56.52)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	709.50	709.50	724.50
STORAGE	17.	17.	123.
OUTFLOW	0.	0.	1945.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.75	724.27	0.00	121.	1848.	0.00	15.75	0.00
.77	724.34	0.00	122.	1905.	0.00	15.75	0.00
.79	724.41	0.00	122.	1934.	0.00	15.75	0.00
.8	724.51	.01	123.	1996.	.25	15.75	0.00